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ABSTRACT

Designed to develop creativity in young learners, this book contains interdisciplinary activities which focus on the theme of energy. Activity pages are provided that can serve as front and back covers of a student booklet and the suggested activities can be duplicated for insertion between the covers resulting in a booklet for each student. A teacher/parent guide is included and supplies background information, activity descriptions, materials needed, and possible answers for the activities. A variety of exercises are provided on such topics as: (1) atomic energy; (2) chemical energy; (3) electrical energy; (4) fossil fuels; (5) heat energy; (6) solar energy; (7) recycling, and (8) personal energy. (ML)

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YOUNG SCIENTISTS EXPLORE

An Encyclopedia of Energy Activities

BOOK 8 INTERMEDIATE LEVEL

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YOUNG SCIENTISTS EXPLORE

AN ENCYCLOPEDIA OF ENERGY ACTIVITIES

Book 8 -- Intermediate Level

By **Jerry DeBruin**

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PREFACE

A NOTE TO TEACHERS AND PARENTS

Dear Friends,

Thank you for the many kind comments about my previous books, *Creative, Hands-On Science Experiences* (CHOSE) published by Good Apple, Inc., in 1980 and the first six books in the *Young Scientists Explore* series published by Good Apple, Inc., in 1982 and 1983.

This book *Young Scientists Explore an Encyclopedia of Energy Activities* is written as a result of your comments and suggestions, comments that suggested a need for handy science books that contain activity sheets which could be duplicated for students' use. *Young Scientists Explore an Encyclopedia of Energy Activities* is an attempt to meet this need.

Young Scientists Explore an Encyclopedia of Energy Activities is the eighth in a series of books that features science activity sheets which provide youngsters with a variety of interesting and challenging science-related experiences using experiments, puzzles, cutouts, hidden pictures, grids, charts, and seek-a-words. Youngsters are encouraged to gain firsthand experience while doing the activities, for it is through firsthand experience that meaningful learning occurs. Emphasis throughout the book is placed on the development of creativity in the learner. It is hoped that this creativity will be nurtured both during and after the activities are done.

You, as teachers and parents, are encouraged to make duplicating masters, copies and transparencies from the pages found in *Young Scientists Explore an Encyclopedia of Energy Activities*. The activities are interdisciplinary and nonsequential in nature and are meant to integrate and extend existing science instruction with other academic areas with the use of extending activities designated by the word "extra" found in the activities themselves. In addition, the book contains a Teacher/Parent Guide that supplies possible answers and special tips where applicable. When completed and mounted on single-layered cardboard and bound with tape, activity sheets 1 and 28 make up both the front and back covers of the Student Booklet. Completed student activity sheets can then be inserted between these covers and placed in a three-ring binder or file folder with the result being a permanent booklet for each youngster.

It is hoped that these activity sheets will touch many minds, hearts and hands and that much personal growth is experienced by all who do the activities. Keep in touch. Let me know how you are doing. It is always good to hear from you. Until then, best wishes in your continued growth as a scientist and complete human being.

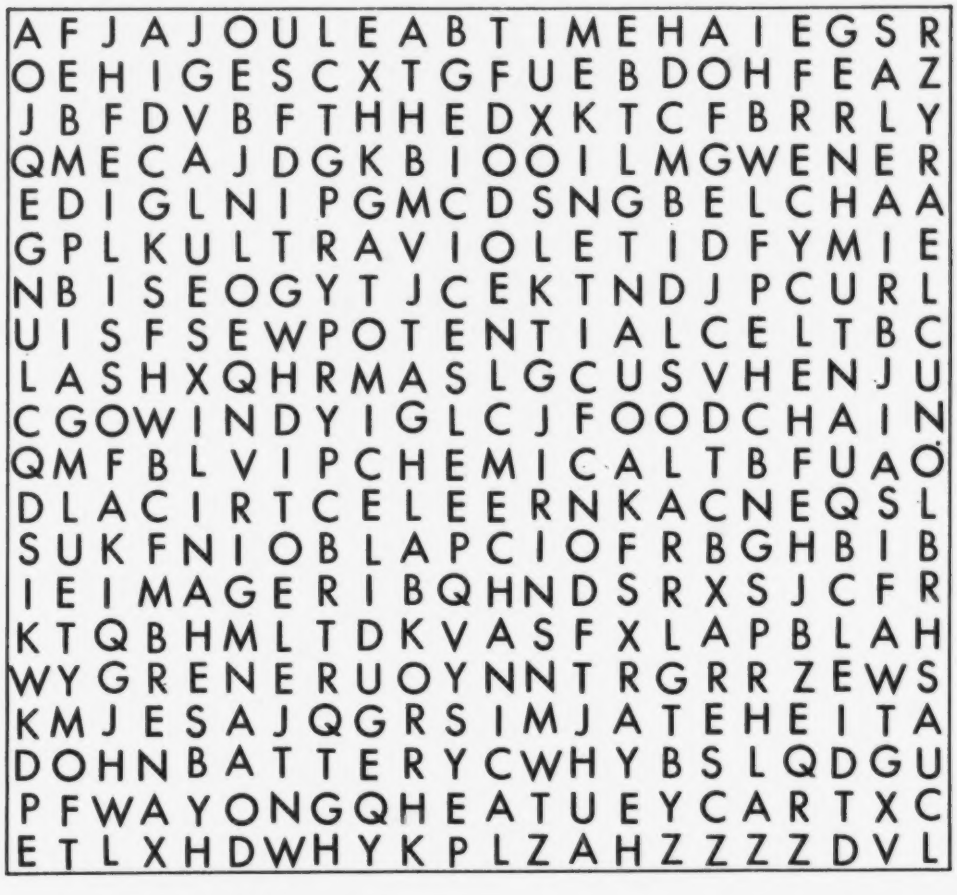
Sincerely,

Jerry DeBruin

The Word Is Energy

Circle the energy-related words in the puzzle below. These words are the names of activities in this book. On the back of this page, write the meaning of each word. Good luck in your study of energy.

Words: atomic, battery, chemical, DOE, electrical, food chain, fossil, gas, heat, infrared, joule, kinetic, light, mechanical, nuclear, oil, potential, quantum, renew, recycle, solar, time, ultraviolet, values, wind, x-ray, your energy, zzzz.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O E H I G E S C X T G F U E B D O H F E A Z
J B F D V B F T H H E D X K T C F B R R L Y
Q M E C A J D G K B I O O I L M G W E N E R
E D I G L N I P G M C D S N G B E L C H A A
G P L K U L T R A V I O L E T I D F Y M I E
N B I S E O G Y T J C E K T N D J P C U R L
U I S F S E W P O T E N T I A L C E L T B C
L A S H X Q H R M A S L G C U S V H E N J U
C G O W I N D Y I G L C J F O O D C H A I N
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D L A C I R T C E L E E R N K A C N E Q S L
S U K F N I O B L A P C I O F R B G H B I B
I E I M A G E R I B Q H N D S R X S J C F R
K T Q B H M L T D K V A S F X L A P B L A H
W Y G R E N E R U O Y N N T R G R R Z E W S
K M J E S A J Q G R S I M J A T E H E I T A
D O H N B A T T E R Y C W H Y B S L Q D G U
P F W A Y O N G Q H E A T U E Y C A R T X C
E T L X H D W H Y K P L Z A H Z Z Z Z D V L

ERGY...
SCHOOL
INDUSTRY
NAME
OIL
YOUNG SC
IENTISTS E
XPLORE EN
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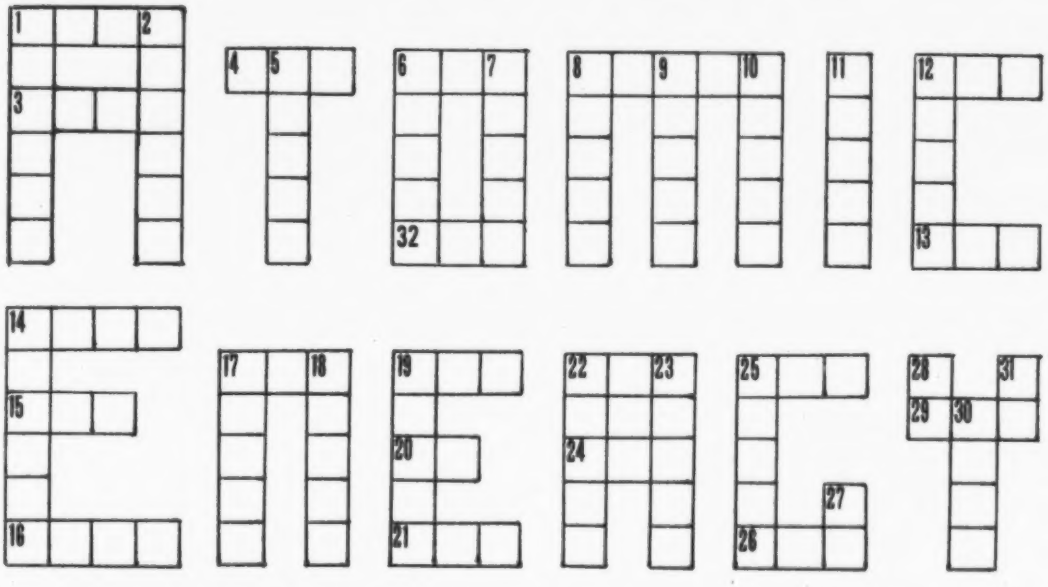
GAS & EL
ECTRIC

ATOMIC ENERGY

Complete this challenging, atom-smashing and mind-boggling crossword puzzle. Use the words below to help you with your task.



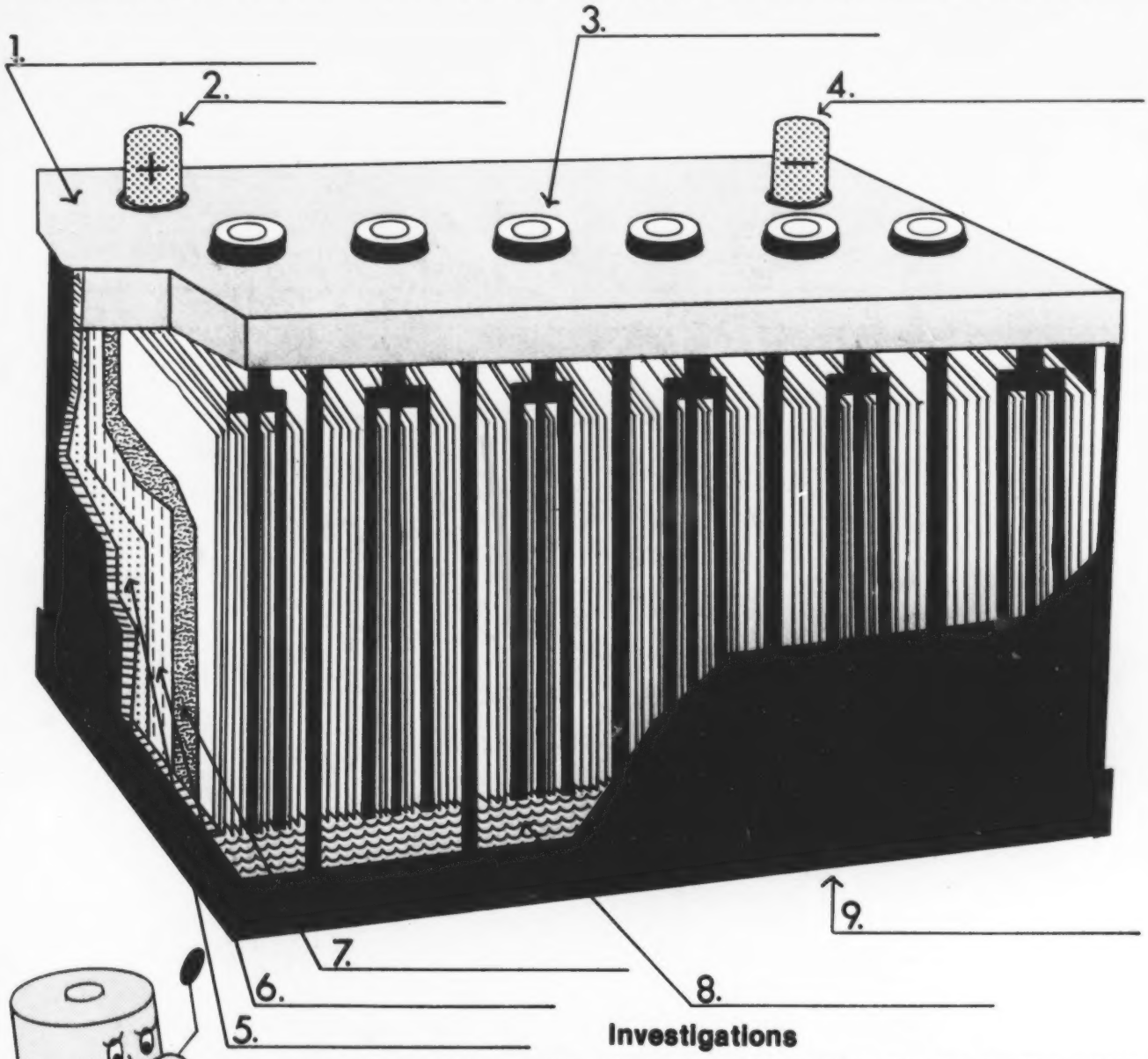
DOWN: (1) Substances composed of two or more metals. (2) Slang word for doctor. (5) Electron path. (6) Low, penetrating, nuclear particle. (7) Energy released from nuclear reaction can be used to produce_____. (8) A gun-type instrument used to detect radiation. (9) _____ activity. (10) Radioactive Thorium 225 has a half-life of _____ minutes. (11) Italian who designed and operated first successful nuclear reactor. (12) Used in swimming pool reactor as a moderator. (14) Protects people from radiation. (17) Term used to describe disintegration of radioactive atom. (18) Uranium is found in the _____. (19) The most penetrating of all radiation. (22) A _____ reaction splits atoms. (23) Element used in nuclear control rods. (25) In medicine, radioactive materials trace the path of _____. (27) Symbol for the 66th element. (28) Symbol for the 27th element. (30) Some elements are classified as _____ earths. (31) Chemical symbol for iron.

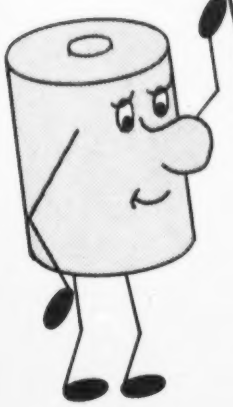
ACROSS: (1) Smallest part of an element that retains its characteristics. (3) Element used as a shield from radiation. (4) Slang for radioactive. (6) Unit of electricity. (8) Measure of rate at which radioactive material gives off particles. (12) First nuclear weapon helped end a _____. (13) _____ materials are basic materials. (14) A unit of fuel. (15) An atom that has lost one or more of its electrons. (16) Amount of radiation received. (17) Main part of a cyclotron. (19) To separate Uranium 235 from U-238, a uranium compound is changed to a _____. (20) Chemical symbol for molybdenum. (21) Radioactive carbon is used to determine the _____ of many prehistoric materials. (22) Radioactive phosphates used on a corn crop show up in the _____. (24) _____ becomes contaminated from nuclear fallout. (25) Abbreviation for unit used to measure heat. (26) Radioactive material lasting only a _____ would have a short half-life. (29) _____ must first be mined before uranium can be refined. (32) Cools graphite reactor.

Words to choose from: alloys, ore, Dy, dee, orbit, air, decay, war, cutie, day, medico, ion, Fermi, slug, eight, BTU, boron, air, gamma, cob, chain, gas, alpha, amp, shield, hot, power, atom, radio, lead, water, curie, earth, raw, blood, Mo, rare, dose, Co, age, Fe

BATTERY

The storage battery, called a lead-acid cell, produces and stores electrical energy. Chemicals mix together to make an electric current. Below is an inside view of a car battery. Using the words below, label each part of the battery. Then complete the investigations below. EXTRA: Find out what it means to "jump" a car. Learn proper safety precautions when using such techniques. Words: positive pole, negative pole, cover, case, positive plates, negative plates, separators, acid, and filler cap.





Investigations

(1) Color the separators yellow, the negative plates silver and the positive plates brown.

(2) Color the hard rubber case black, the filler caps green and the acid gray.

(3) Find out the number of cells and volts per cell in the above battery.

(4) With help from your parents, look at the family car battery and record the date on which it was purchased.

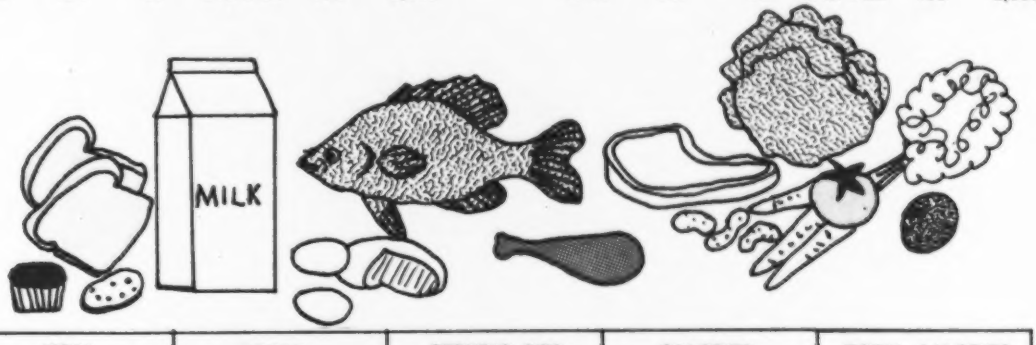
(5) Find the difference between a storage battery and a dry cell.

CHEMICAL ENERGY

Almost all energy comes from the sun. Foods contain chemical energy which is used for body heat and motion. When you eat and digest food, you actually use chemical energy from the sun. Chemical energy from food is measured in calories. In the chart below, record the names and amounts of food eaten in one day. Using a nutrition book, look up and record the number of calories for each kind of food consumed. Record the total number of calories. Circle your age range in the chart below. Find out if you are above or below the recommended daily dietary allowances for a youngster in your age range. Then design a bumper sticker that would show others how you feel about proper nutrition and diet. EXTRA: Plan a weekly menu of nutritious foods.

Recommended Daily Dietary Allowances

Boys Age (yrs.)	Weight (lbs.)	(kg)	Height (ft. in.)	(cm)	Calories	Girls Age (yrs.)	Weight (lbs.)	(kg)	Height (ft. in.)	(cm)	Calories
9-12	72	33	4 ft. 7 in.	140	2,400	9-12	72	33	4 ft. 7 in.	140	2,200
12-15	98	45	5 ft. 1 in.	155	3,000	12-15	103	47	5 ft. 2 in.	157	2,500
15-18	134	61	5 ft. 8 in.	173	3,400	15-18	117	53	5 ft. 4 in.	163	2,300

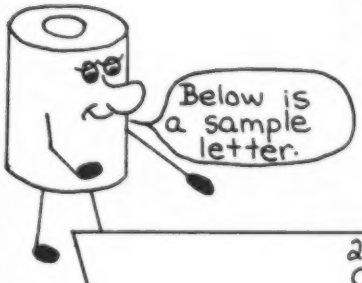


MEAL	FOOD	SERVING SIZE	CALORIES	TOTAL CALORIES
BREAKFAST				
LUNCH				
DINNER				
SNACKS				

Date_____ **Total Calories Today**_____

DEPARTMENT OF ENERGY

The Department of Energy seal has drawings on a shield that represent various kinds of energy. Write the correct word in the blank for each form of energy. Color the seal. Then write a letter to the Secretary of Energy asking for information on what you can do to conserve energy. Words to choose from: solar, nuclear, wind, petroleum, and hydroelectric. EXTRA: Make an energy scrapbook. Glue the energy seal to the cover of your scrapbook for all to see.



2626 Your St.
City, State Zip
Month, Day Year

← Place your return address.

Jill Hall
2626 Your St.
City, State ZIP

Inside Address → Secretary, Department of Energy
Forestral Building
Independence Avenue, S.W.
Washington, D.C. 20585

Greeting → Dear Sir:

Body → We are studying energy conservation in school. Please send me any free information you have on energy conservation. I am especially interested in how I can help save energy at home.

Closing → Sincerely,

Your Signature → Jill Hall

Secretary, Department of Energy
Forestral Building
1000 Independence Avenue, S.W.
Washington, D.C. 20585

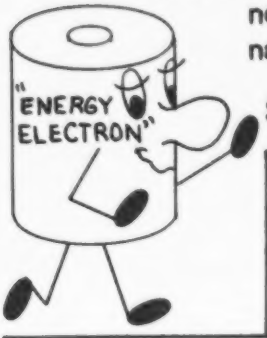
This is the Department of Energy address.

ELECTRICAL ENERGY

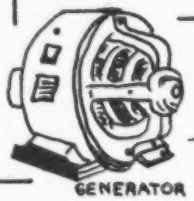
Electrical energy is generated at a power plant near your home. In the maze below, trace the path that Energy Electron must take to light the light bulb in the lamp. Measure this distance in inches (cm). On the back of this page, write a story about what happens at each stop in the maze. EXTRA: Locate the power plant nearest your home that produces your home electricity. Find this distance in miles (km). In the box below, check (✓) the type of fuel needed to produce your electricity. ☐ Nuclear ☐ Fossil (coal, petroluem, natural gas) ☐ Water ☐ Solar ☐ Wind ☐ Tidal ☐ Geothermal

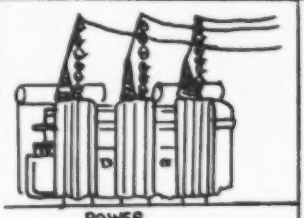
Total Trip in Inches _____ Total Trip in Centimeters _____

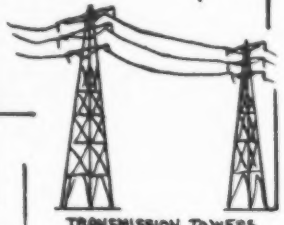
Hint: 1 inch = 2.5 cm

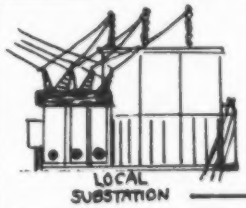


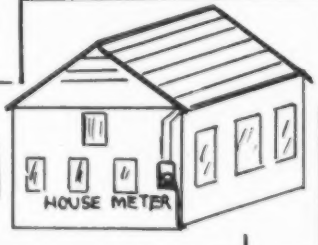
START

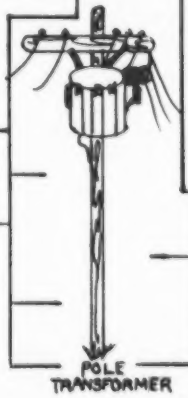


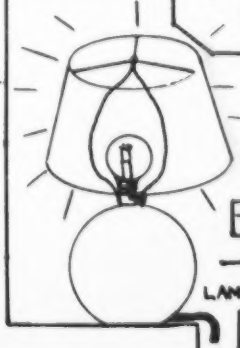








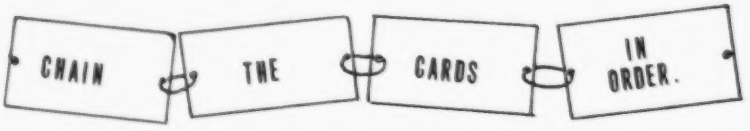




FINISH

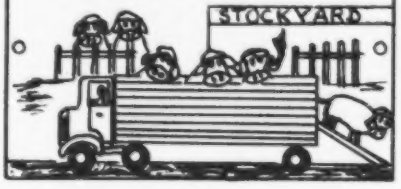
FOOD CHAIN AND FOSSIL FUELS

Vast amounts of energy are needed to produce the food we eat. Below are 12 cards that show various steps taken when meat is produced. Cut cards apart and string together to make a chain that shows the correct sequence of events. Check (✓) the box on each card if that step required the use of a fossil fuel (coal, petroleum or natural gas) to produce the food. EXTRA: Develop an energy chain that involves the production of one nonfood item.

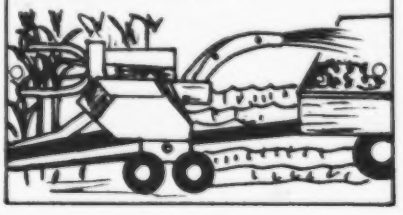


☐ MEAT IN SUPERMARKET FROM PROCESSOR.

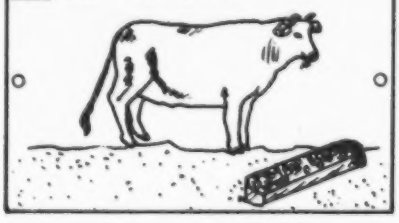
☐ COW TO STOCKYARD SLAUGHTERHOUSE.



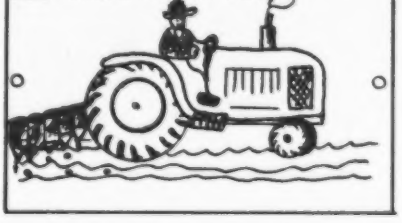
☐ FARMER CHOPS CORN.



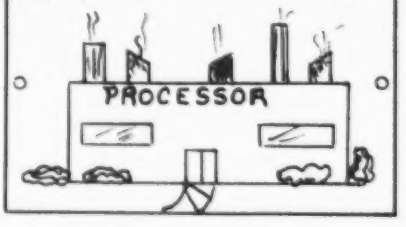
☐ COW EATS CORN.



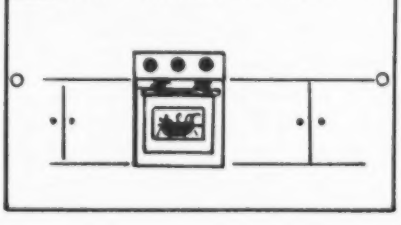
☐ FARMER PLANTS SEEDS.



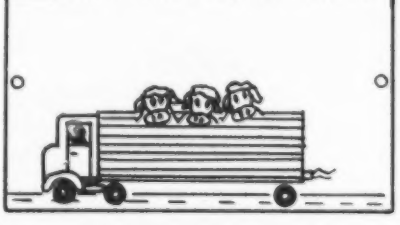
☐ MEAT TO MEAT PROCESSOR.



☐ MEAT COOKING IN OVEN.



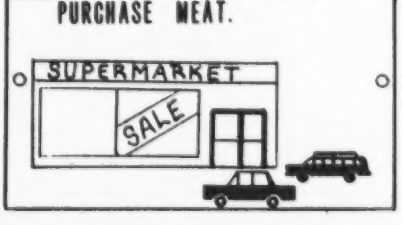
☐ COW TRANSPORTED ON TRUCK.



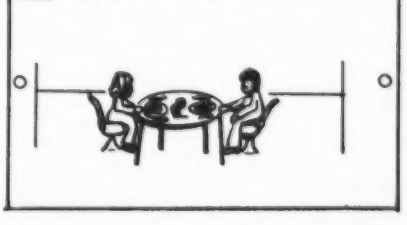
☐ FARMER IRRIGATES CORN PLANTS.

☐ FARMER CULTIVATES SMALL CORN PLANTS.

☐ CAR TO SUPERMARKET TO PURCHASE MEAT.

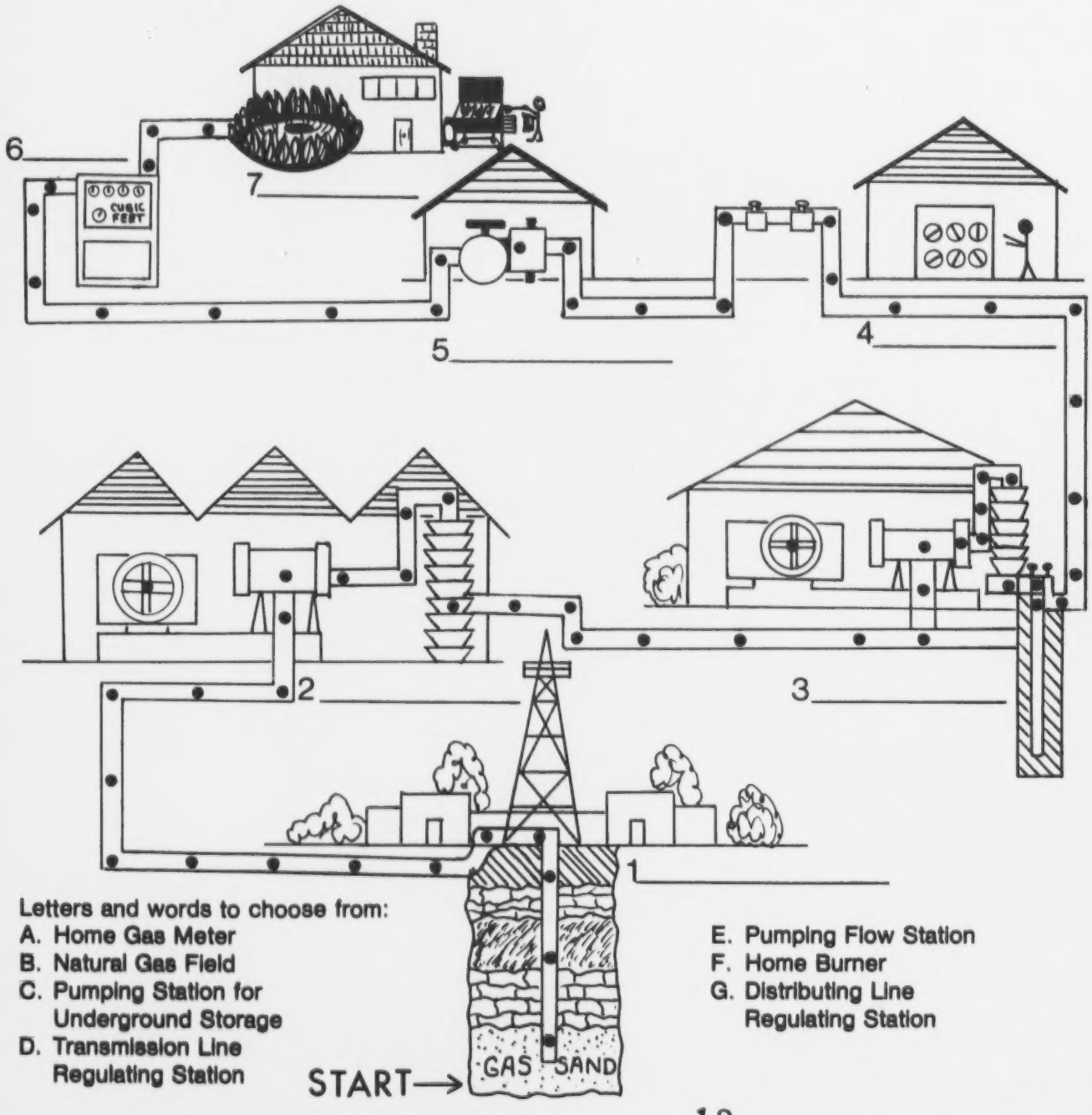


☐ PEOPLE EATING MEAT.



GAS

Starting at Gas Sand, connect the dots in the picture below to show the flow of natural gas from the gas field to a gas burner in your home. At each of the seven stops, choose from the words below and write the letter of the name of the stop in the corresponding blank. Find out what happens to the gas at each stop on the way to your home. EXTRA: Make a list of at least five items that need natural gas to operate. Some of these items may also operate on electricity in your home.



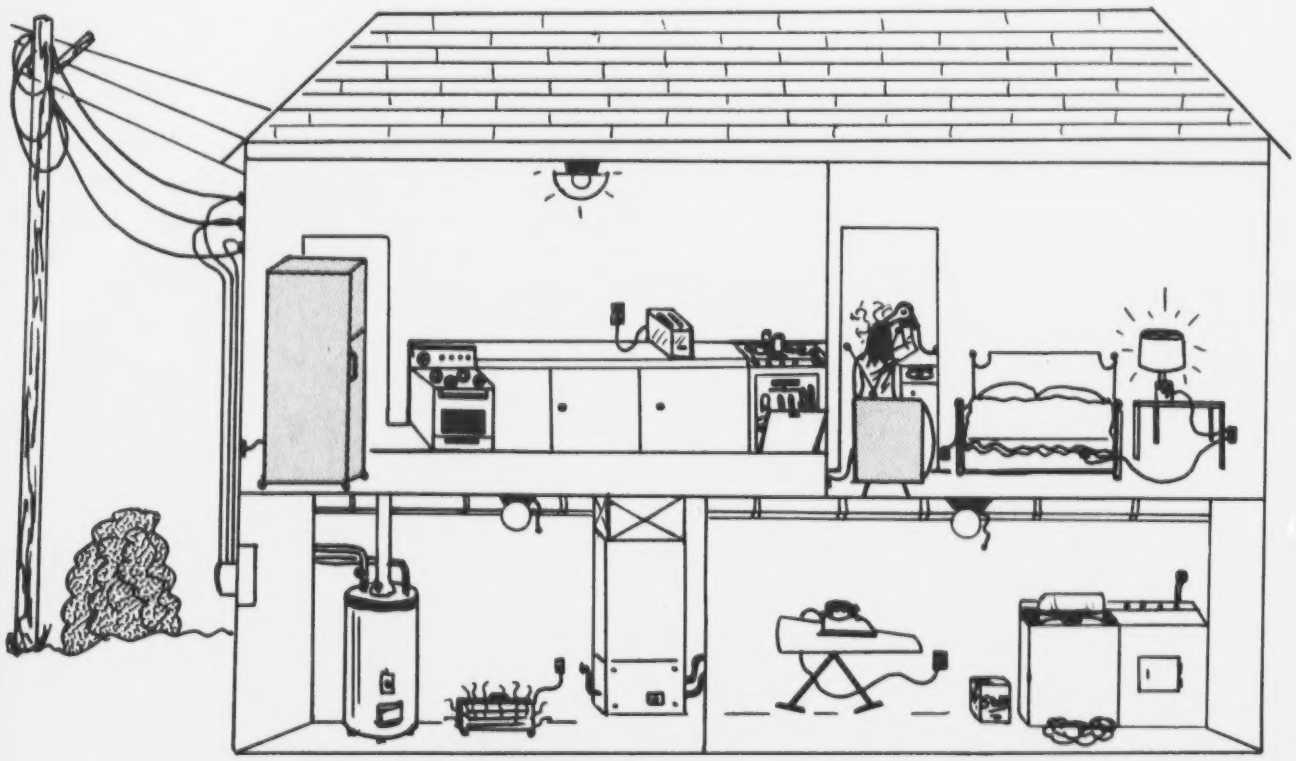
Letters and words to choose from:

A. Home Gas Meter
B. Natural Gas Field
C. Pumping Station for Underground Storage
D. Transmission Line Regulating Station
E. Pumping Flow Station
F. Home Burner
G. Distributing Line Regulating Station

HEAT ENERGY

Heat energy is an important form of energy. In the United States, more than half of all the energy people use is for heat. Below is a picture of your home and its contents. Find and circle the objects that, when working, give off heat energy. Then, from the list below, classify these energy users into three groups: (H) high energy user (more than $50 per year); (M) medium ($10-$50) and (L) low (less than $10 per year). EXTRA: Conclude your study by drawing a cartoon that shows at least one way to conserve heat energy.

Item	Classification (HML)	Item	Classification (HML)
1. Home space heater		8. Clothes dryer	
2. Washing machine		9. Refrigerator	
3. Dishwasher		10. Range and oven	
4. Toaster		11. Electric blanket	
5. Water heater		12. Home lights	
6. Iron		13. Furnace	
7. Hair dryer		14. Television	



INFRARED ENERGY

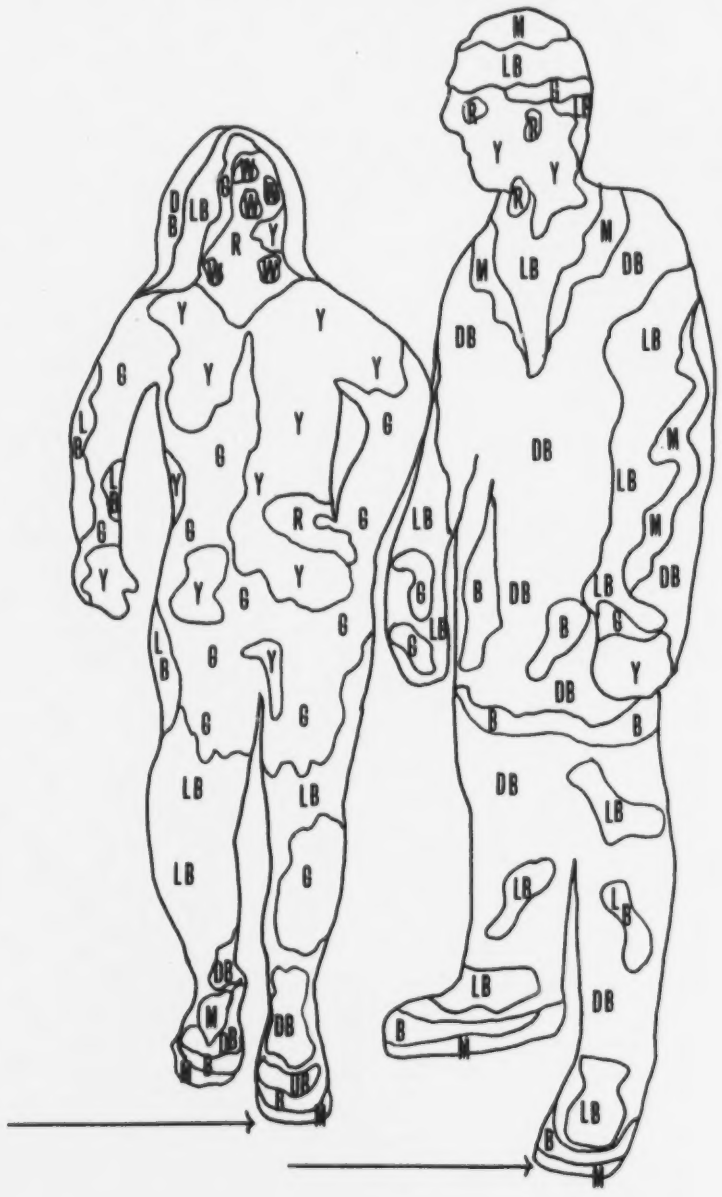
Special infrared film is used to show how objects give off heat energy that cannot be seen by the human eye. The amount of heat energy given off by objects is shown on the scale below: white for warmest (most heat given off), black for coolest (least heat given off).

Different types of clothes are worn during different seasons of the year. One person below wears summer clothes, the other winter clothes. Use the coded letters on the scale, ("R" is red), to color in the lettered areas on each person below. Decide which person wears summer clothes and which person wears winter clothes. Write the word *summer* or *winter* in the blank under each figure. Identify the parts of the body that give off the most heat. EXTRA: On the other side of this paper, make a list of things that you can feel but cannot see.

Warmest

White (W)
Red (R)
Yellow (Y)
Green (G)
Light Blue (LB)
Dark Blue (DB)
Magenta (M)
Black (B)

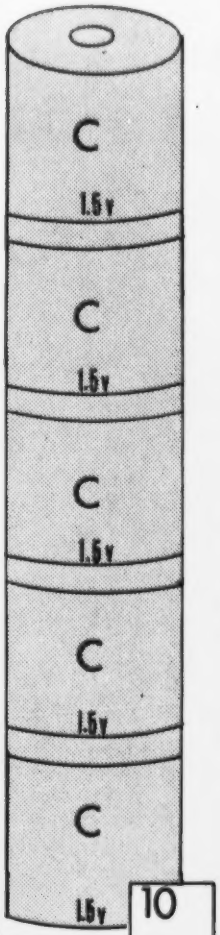
Coolest

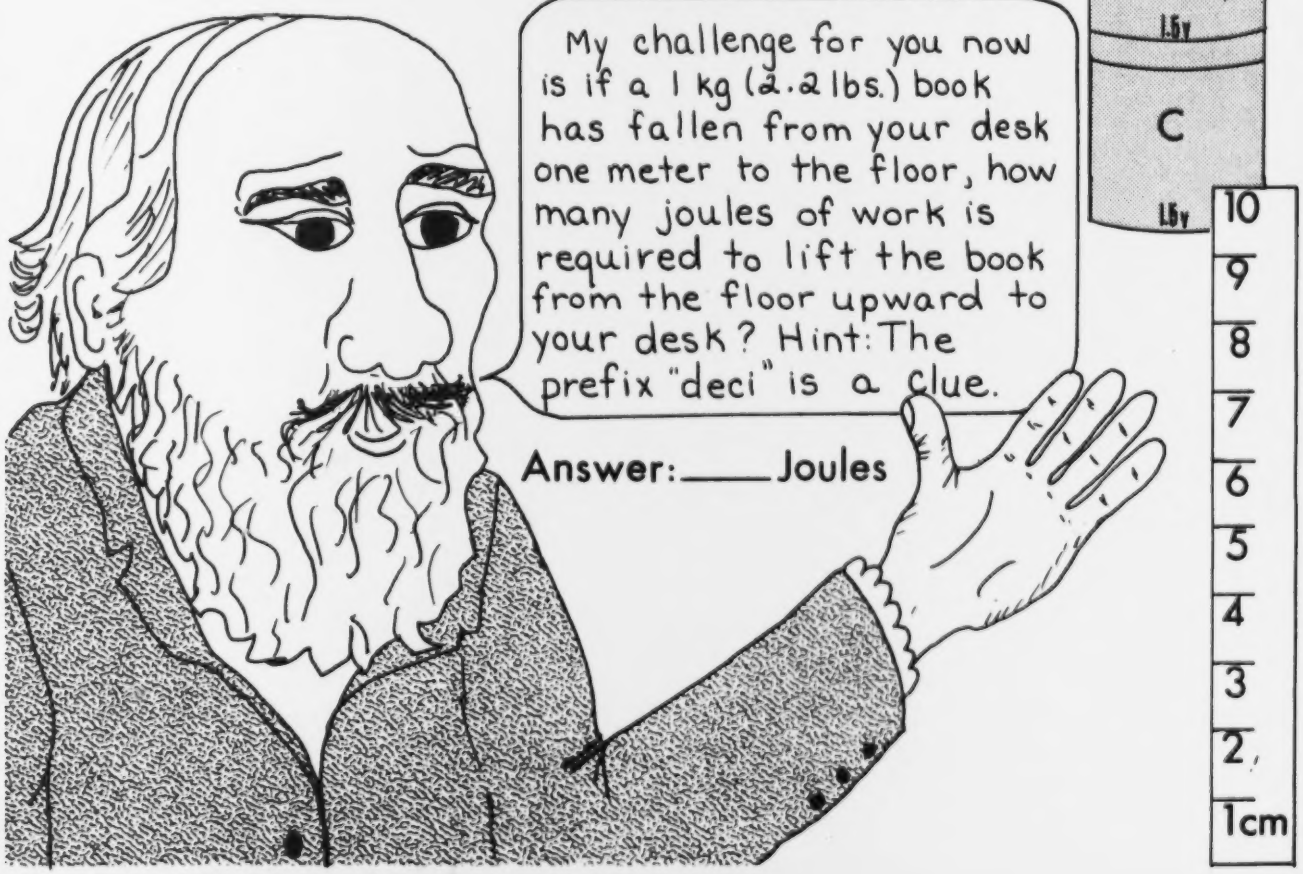


JAMES P. JOULE (1818-1889)

My joule rhymes with the word p __ __ l. It's named after me, James P. J __ __ __ __. I invented the joule which is the unit of w __ r k and e __ e __ g y in the S I, the international system of units. When w o __ k is done, __ n e r __ y goes from one system to another. The system doing the __ o r __ loses some __ n e r g __ equal to the amount of w __ __ k done. The system on which the w __ __ k is done gains an equal amount of e n e r g __. Some leftover __ __ __ __ __ y is given off as h e __ t. Thus, my __ o u l e is a unit of both w o r k and e n e r g y.

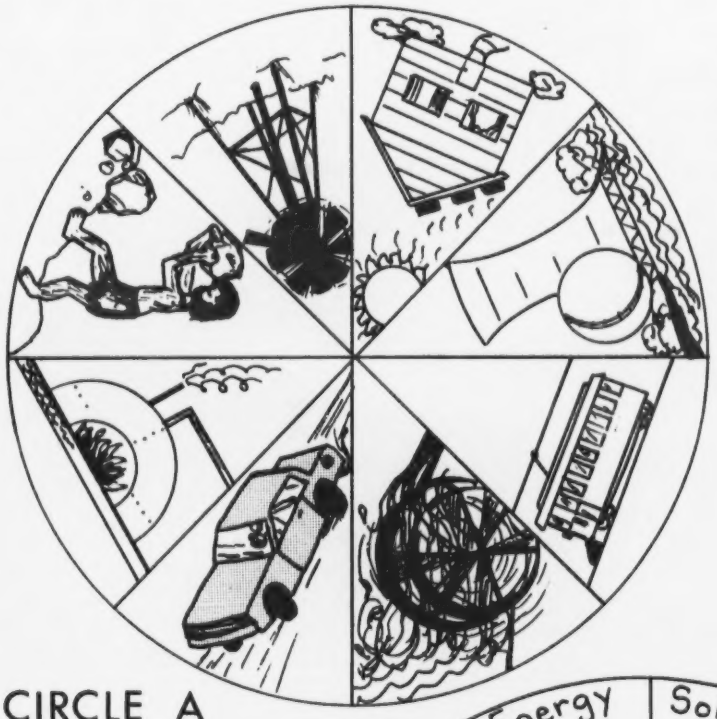
How much is a j o u l e of w o r k? You can find out by doing this experiment. Tape 5 "c" size dry cells (found in electronic toys) end to end. Together, they weigh about 1 kg (2.2 lbs.). Stand this page upright. Place top of dry cells at 1 cm mark. Lift the five dry cells upward 10 centimeters. You have done about one j o u l e of w o r k. EXTRA: Complete the challenge activity below using a 1 kg book or its equivalent in weight or mass.



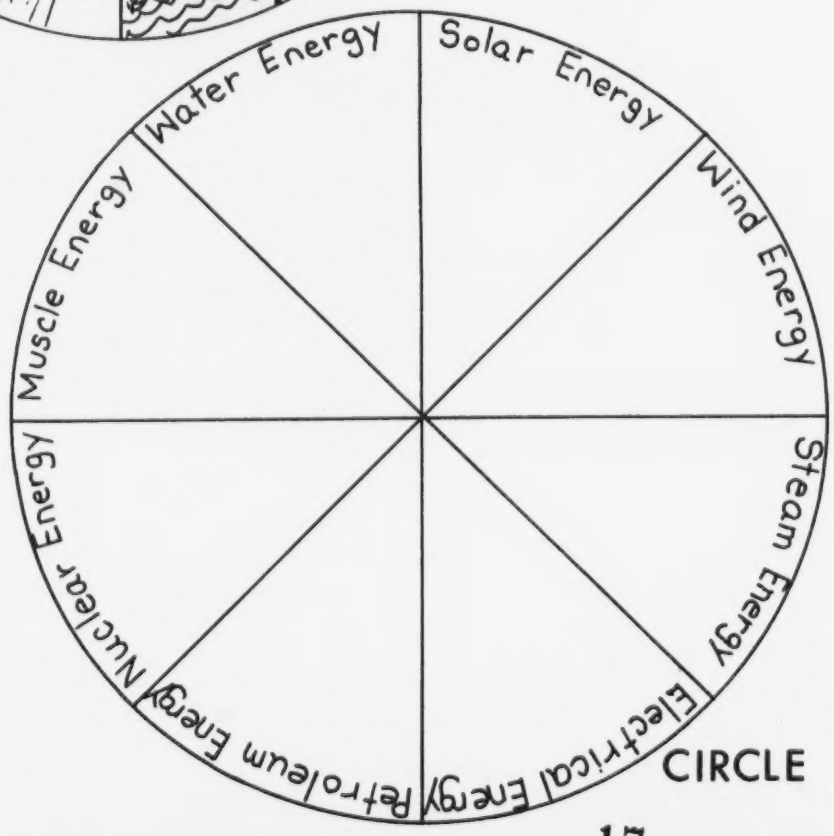

CHALLENGE ACTIVITY:
My challenge for you now is if a 1 kg (2.2 lbs.) book has fallen from your desk one meter to the floor, how many joules of work is required to lift the book from the floor upward to your desk? Hint: The prefix "deci" is a clue.
Answer: ____ Joules
10
9
8
7
6
5
4
3
2
1cm

KINETIC ENERGY

Kinetic energy is the energy of anything that is moving. Use your kinetic energy to make the spinner below. Cut out circles A, B and the pointer. Mount on single-layered cardboard. Punch holes in centers of circles A, B and pointer. Place pointer on top of circle A and circle A on B. Insert cardboard disc between circles to act as a washer. Attach at centers with paper fastener or straightened paper clip. Spin pointer. Read name of type of kinetic energy on circle B. Then rotate circle A until it matches the object moved by that type of kinetic energy. Make other kinetic energy wheels by matching the type of kinetic energy with the object that is being moved. EXTRA: Show friends your favorite kinetic energy movement.



CIRCLE A



CIRCLE B

17

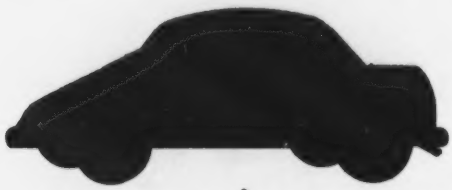
LIGHT ENERGY

Light energy travels in waves. Sometimes, objects block out light waves from the light source itself. This shielding results in a shadow. Below are shadows made by energy-related objects. Use the clue to identify each shadow cast by the objects. Then design a shadow of your favorite creature or thing whose shadow can be seen at night under a street light. EXTRA: Make a silhouette (shadow) of yourself to present to your parents.

1. H + AIR + + ER

_____

2. Fe _____

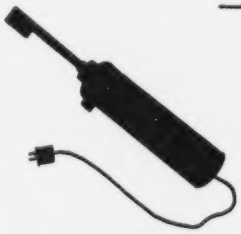


4. AUTO + _____

5. 120° F (49°C)

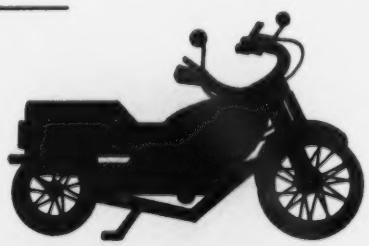
_____

6. + ER _____



7. + +

_____



8. IN + + DES +

_____

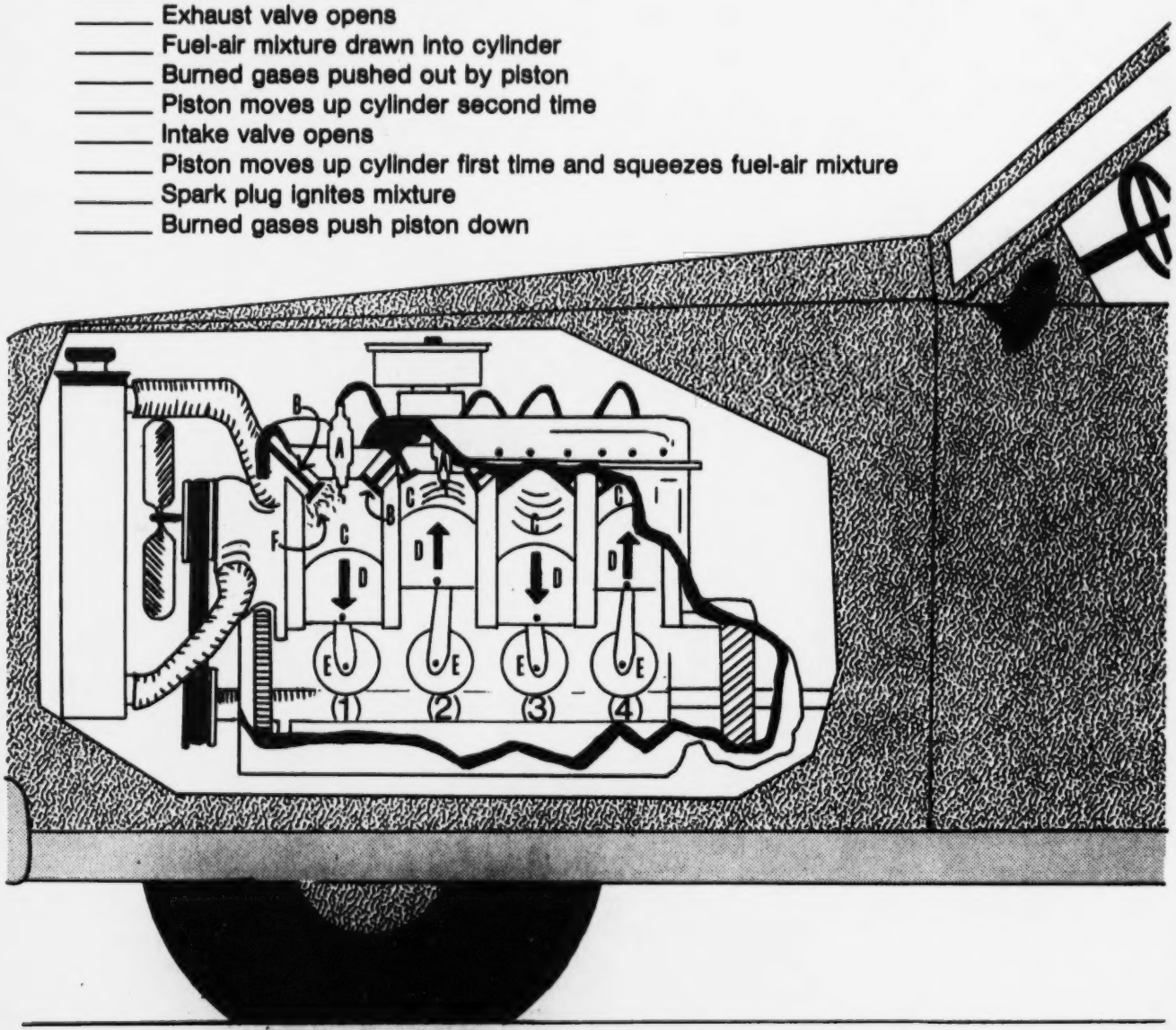
9. MOTOR +

_____

MECHANICAL ENERGY

Heat energy can be changed into mechanical energy to do work. A gasoline-powered engine such as the one found in your car is an example of how heat energy is changed into mechanical energy and work. Below are pictures of a four-cyclinder, four-cycle gasoline engine. Locate (a) spark plug, (b) intake valve, (c) cylinder, (d) piston, (e) crankshaft and (f) fuel-air mixture. Observe the position of the piston during the Intake Stroke (Figure 1), the Compression Stroke (Figure 2), Power Stroke (Figure 3) and Exhaust Stroke (Figure 4). Number the statements in order below to show the correct sequence of events in the operation of a four-stroke, four-cycle gasoline engine. The first one is done for you. EXTRA: Interview a mechanic to learn how a diesel engine works. Record your results in your science logbook.

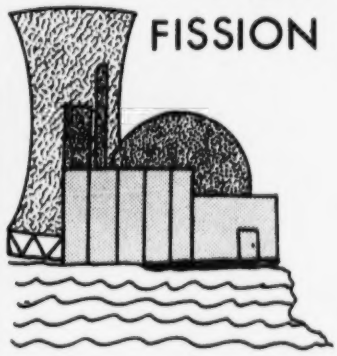
__1__ Piston moves down cylinder
_____ Exhaust valve opens
_____ Fuel-air mixture drawn into cylinder
_____ Burned gases pushed out by piston
_____ Piston moves up cylinder second time
_____ Intake valve opens
_____ Piston moves up cylinder first time and squeezes fuel-air mixture
_____ Spark plug ignites mixture
_____ Burned gases push piston down

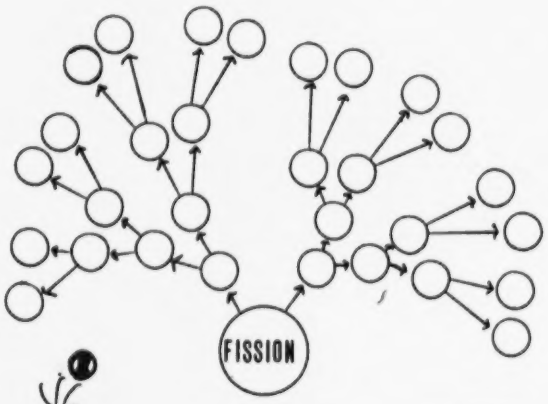


NUCLEAR ENERGY

Nuclear energy is made when atoms of certain elements such as uranium are split. This splitting is called FISSION. Someday, scientists hope to develop energy by putting certain elements together. This process is called FUSION. For fun, flip a coin 30 times to determine whether nuclear fission or fusion has the best chance of becoming the main source of energy in the future. Start at the large circles. For every "heads," color in one atom of fission, for every "tails," one atom for fusion. Record the number of each in the blanks. Tell whether nuclear fission or fusion eventually survives as a sole source of energy. Record results in the results blank. EXTRA: Write a news feature story for the newspaper on the chances one takes with the use of nuclear fission and fusion.

FISSION

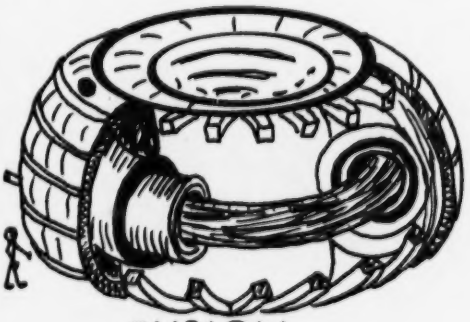


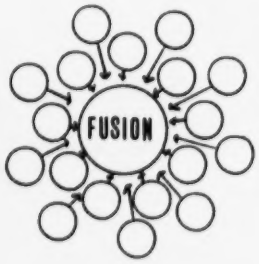


Number of heads: _____

1985: FISSION

2025: FUSION





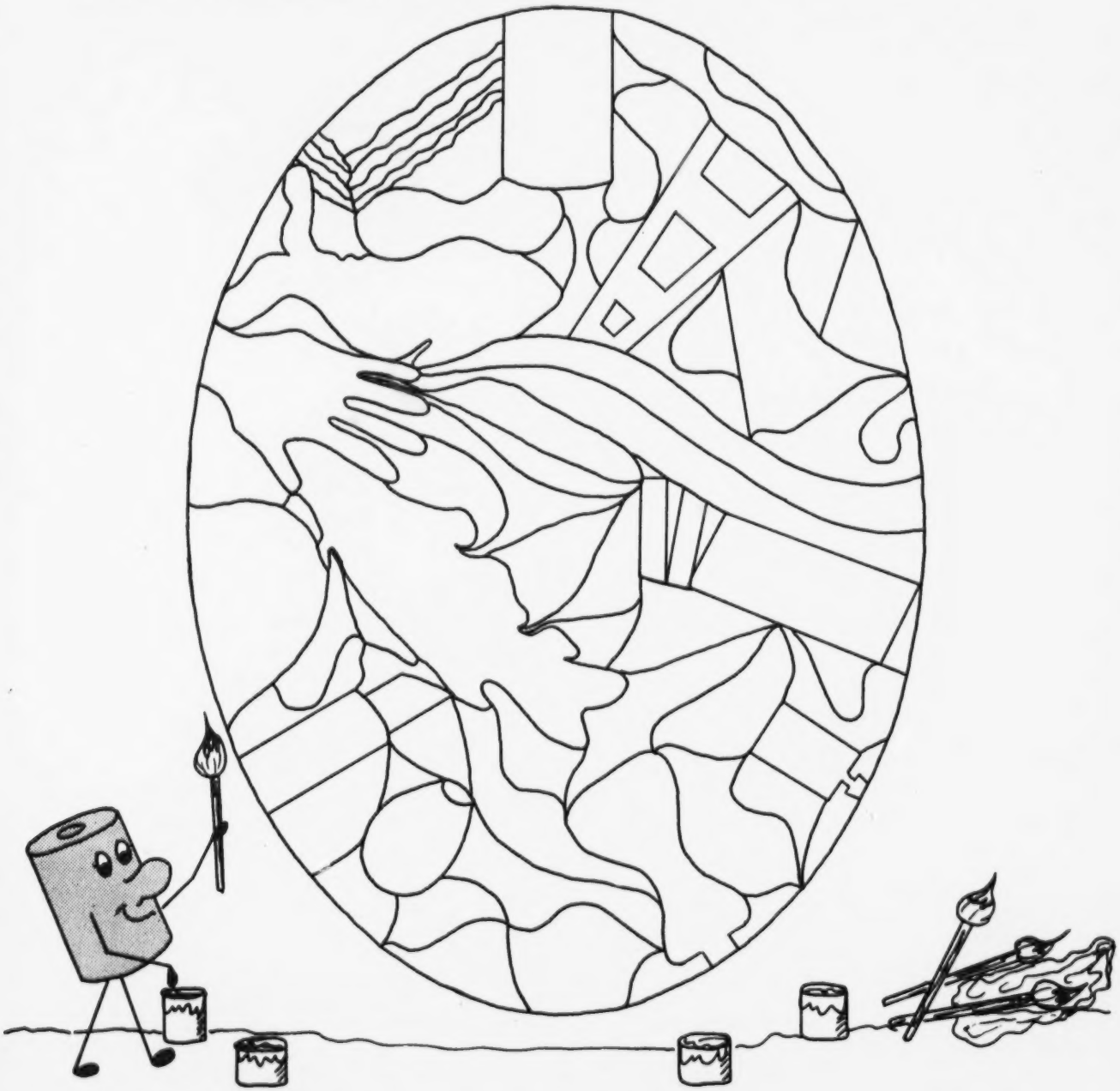
Number of tails: _____

FUSION

RESULTS:
FISSION or FUSION? _____

Oil is an important source of energy. It does not mix with water, breaks up in ether and feels greasy. Artists use various oils when they paint pictures. Below is an oil painting that includes 14 hidden objects which either contain or use oil for energy. Find each object. Then using different colored pens, color each object. Use your imagination and find other objects of your choice in the picture. EXTRA: Gather information on at least one well-known oil painting done by a famous artist.

Oil-related objects to find: (1) bird feather, (2) skin, (3) whale, (4) codfish, (5) motor oil can, (6) vegetable oil jar, (7) asphalt rock, (8) oil derrick, (9) shale rock, (10) butter, (11) olive, (12) multi-purpose oil can, (13) peanut, (14) lipstick.



POTENTIAL ENERGY

Potential energy is stored energy or energy that waits to be used. Potential energy can be changed into kinetic or moving energy. Do this by making the catapult below. You will need two scraps of wood, glue, nails, clay and protractor. Bend banding slightly into L shape and insert "L" end between two pieces of wood. Glue, then nail wood together. Glue protractor vertically on side of catapult slightly toward front. Place ball of clay at tip of banding. Bend to show potential energy. Release to show kinetic energy. In chart A below, record how far the ball of clay travels at each 10° mark. Answer questions in chart B. In chart C, list factors that affect how far you can catapult an object through space. EXTRA: On the other side of this page, make a list of other things that show potential energy. Be sure to include yourself as a source of potential energy.

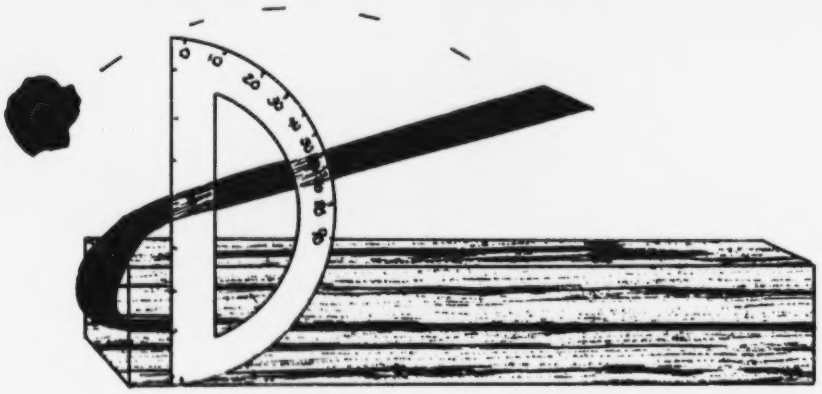


chart A

DISTANCE:		TRIAL 1		TRIAL 2	
		IN.	CM	IN.	CM
NUMBER of DEGREES	10°				
	20°				
	30°				
	40°				
	50°				
	60°				
	70°				
	80°				
	90°				
	Other:				
	Other:				
	Other:				

chart B

(1) How many degrees are needed to catapult the clay one foot?

(2) How many degrees are needed to catapult the clay one meter?

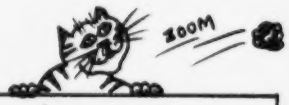
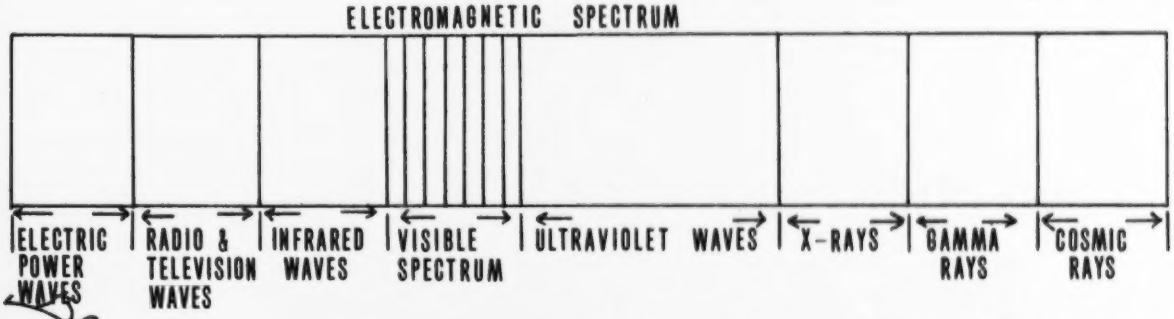


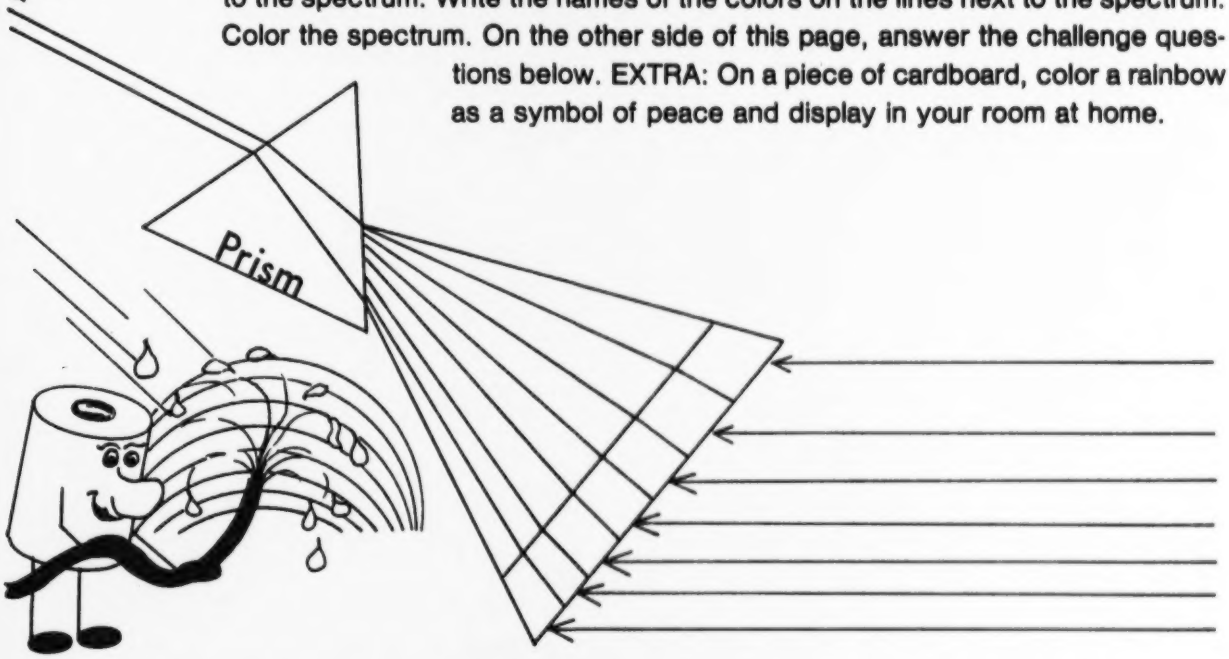
chart C

QUANTUM

A quantum is a bundle of energy that travels in waves. Below is a picture of a spectrum whose waves range from longer electric power waves to shorter cosmic rays. As humans, we see only those waves in the visible spectrum.



In the spectrum, light rays of sunlight or white light can be seen as colors. When a beam of white light or sunlight passes through raindrops or a glass prism, it is broken up into many colors. You can remember the names of these colors by the name ROY G. BIV: Red, Orange, Yellow, Green, Blue, Indigo and Violet. With a pencil, trace the path of light waves from the sun, through the prism and into the spectrum. Write the names of the colors on the lines next to the spectrum. Color the spectrum. On the other side of this page, answer the challenge questions below. EXTRA: On a piece of cardboard, color a rainbow as a symbol of peace and display in your room at home.



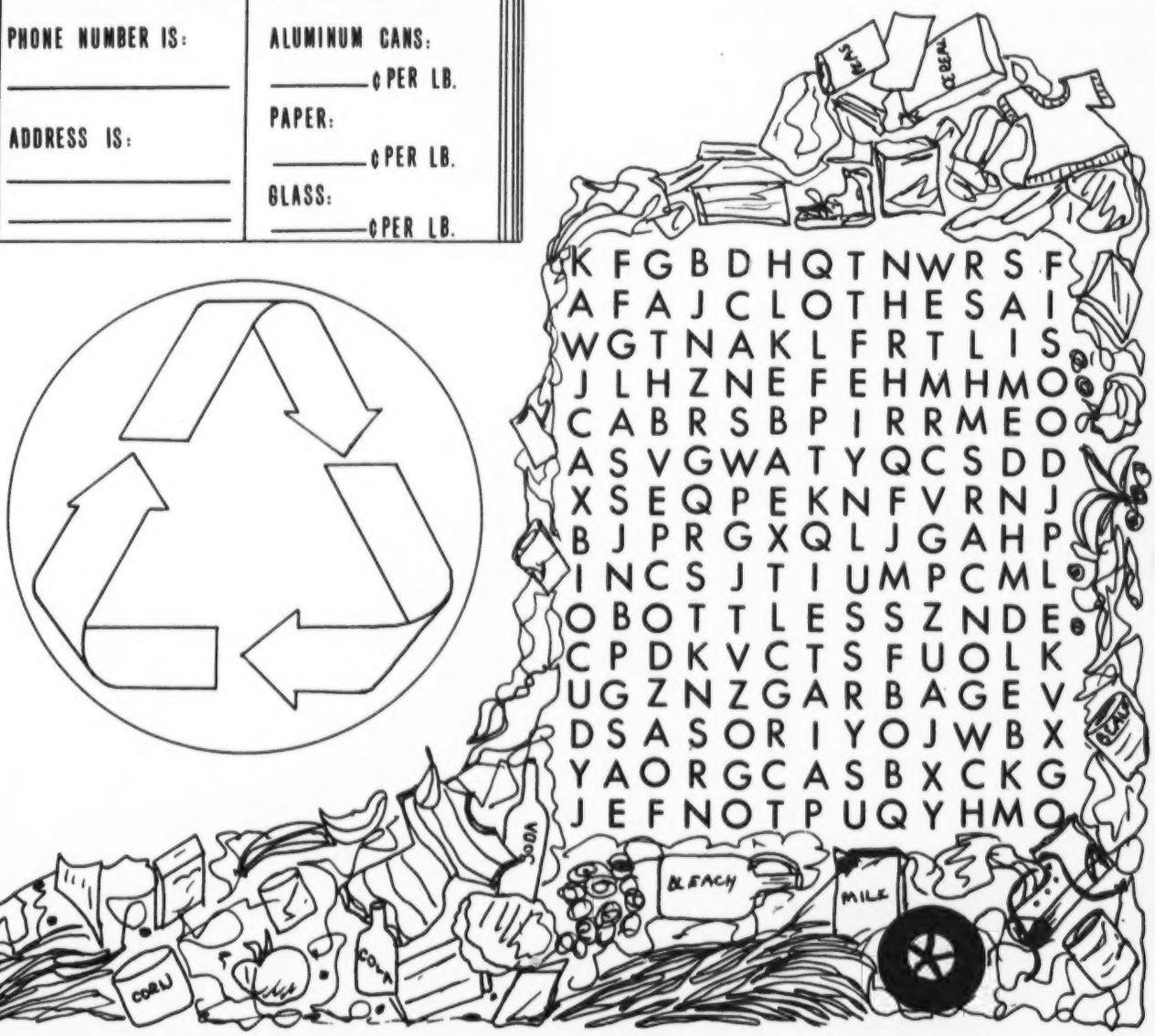
Find the answers to these challenge questions.

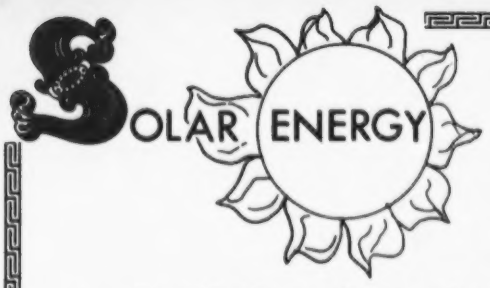
(1) How long does it take for sunlight to reach the earth?
(2) How long is a light year?
(3) How fast does light travel?
(4) What are the primary *light* colors? What are the primary *paint* colors?
(5) What is the fastest and shortest moving light wave in the visible spectrum?
(6) What is the slowest and longest moving light wave in the visible spectrum?
(7) What is quantum mechanics?

RENEW BY RECYCLING

Renewable energy sources are sources of energy that never run out. The sun, wind, water power and hopefully wood are some of these sources. Nonrenewable sources of energy will someday run out. They can never be replaced. Some of these are coal, oil and natural gas. Recycling means the reuse of materials that we have thrown away after using them once. Recycling lessens the drain on our natural nonrenewable resources and helps reduce the amount of trash. Below is a picture of a recycling symbol near a pile of trash. In the word search find and circle the names of these objects that could be recycled: cans, clothes, bottles, garbage, paper, glass, pan, cars, and bag. EXTRA: Call the nearest recycling plant for current price information on recyclable items. Complete the chart below.

MY RECYCLING CENTER'S	PRICES PAID FOR:
PHONE NUMBER IS: _____	ALUMINUM CANS: _____¢ PER LB.
ADDRESS IS: _____ _____	PAPER: _____¢ PER LB.
	GLASS: _____¢ PER LB.


K F G B D H Q T N W R S F
A F A J C L O T H E S A I
W G T N A K L F R T L I S
J L H Z N E F E H M H M O
C A B R S B P I R R M E O
A S V G W A T Y Q C S D D
X S E Q P E K N F V R N J
B J P R G X Q L J G A H P
I N C S J T I U M P C M L
O B O T T L E S S Z N D E
C P D K V C T S F U O L K
U G Z N Z G A R B A G E V
D S A S O R I Y O J W B X
Y A O R G C A S B X C K G
J E F N O T P U Q Y H M O
BLEACH
MILK
COKE



This activity will help you understand what colors absorb the sun's heat best. Cut out and glue matching pieces of construction paper to the squares below or on a separate sheet of paper. Move paper into sun or under a lamp. Place the same size (small) ice cubes on top of each square. Time how long it takes for each ice cube to melt. Record your results in the chart below. Compare your results with those of your classmates. Then answer the true or false questions below. EXTRA: Using aluminum foil and cardboard, build a solar cooker that would cook a hot dog or marshmallow.

White	Green	Blue
Red	Yellow	Black

Color	Start Time	Finish Time	Number of Minutes	Rank
White				
Green				
Blue				
Red				
Yellow				
Black				

TRUE OR FALSE?

____ It is better to wear dark clothes in summer because they absorb less heat.

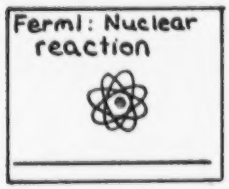
____ A house with a white roof is cooler in summer than a house with a dark roof.

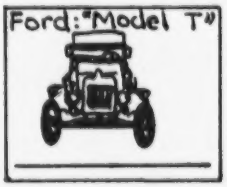
____ It is more expensive to air condition a house with a dark roof in summer.

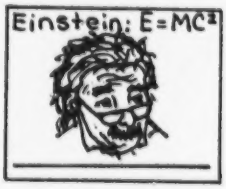
____ It is more expensive to heat a house with a white roof in winter time.

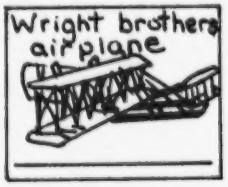
TIME

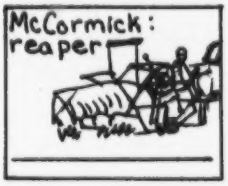
Below are time frames that, when put together correctly, make up an energy time line. Make your own film that shows the History of Energy. On each frame, record the year in which the energy-related event took place. Cut out frames. Place in order from past to present. Glue frames to film. Pull through two-slitted viewer made from a small box, for example, crayon or cereal box. Tell your friends about each event. EXTRA: Write a documentary film entitled "The History of Energy" and show it to the members of your class.

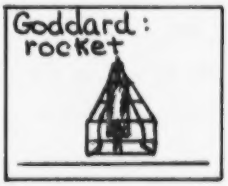


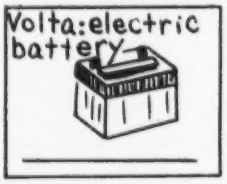


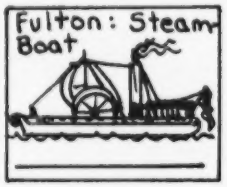


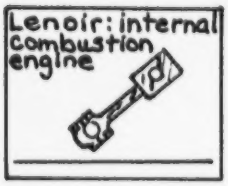


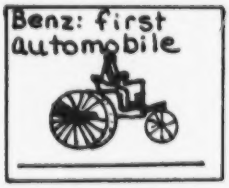


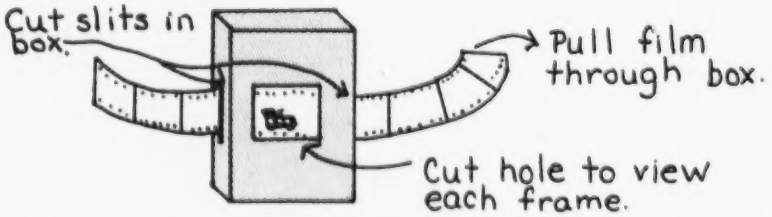












ULTRAVIOLET

Ultraviolet (UV) rays are the part of sunlight that cannot be seen. These rays are very strong and can cause sunburn with possible damage to the skin. Below are statements about ultraviolet rays. Write "T" in the blank if you feel the statement is true, "F" if false.

1. ____ Blue-eyed blondes, redheads with freckles and fair-skinned people are harmed the least by ultraviolet rays.
2. ____ Blacks are affected less by ultraviolet rays than whites.
3. ____ Sun lamps used for tanning the skin give off ultraviolet rays.
4. ____ Ultraviolet rays help produce Vitamin D which is used to cure rickets.
5. ____ Ultraviolet rays help prevent colds.
6. ____ Ultraviolet rays destroy harmful organisms such as viruses and bacteria.
7. ____ Long ultraviolet rays cannot go through window glass.
8. ____ Hospital surgical instruments are sterilized by ultraviolet rays.
9. ____ Ultraviolet rays can irritate the eyes, so polarized glasses should be worn.
10. ____ The ozone layer absorbs many ultraviolet rays and thus protects the earth.
11. ____ Ultraviolet rays cannot cause skin cancer.
12. ____ Ultraviolet rays from the sun are most intense between 10 a.m. and 2:00 p.m.
13. ____ Ultraviolet rays can travel through clouds and water so one can get sunburned on a cloudy day or while in the water.
14. ____ Sand and snow cannot reflect ultraviolet rays so it's not possible to get a sunburn while on a ski slope or beach.

Directions: Sunscreens absorb UV rays before they can harm your skin. Bottles of sunscreen have numbers that tell you how much protection you can get, the higher the number, the more protection. In the blank, write the skin type of the person whose complexion best matches the appropriate bottle of sunscreen. EXTRA: With your classmates, make a TV commercial that tells how sun block lotion guards against sunburn caused by UV rays.

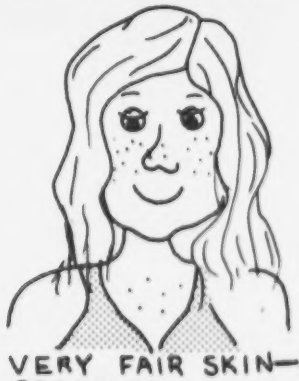
____

____

____

____

MEDIUM SKIN

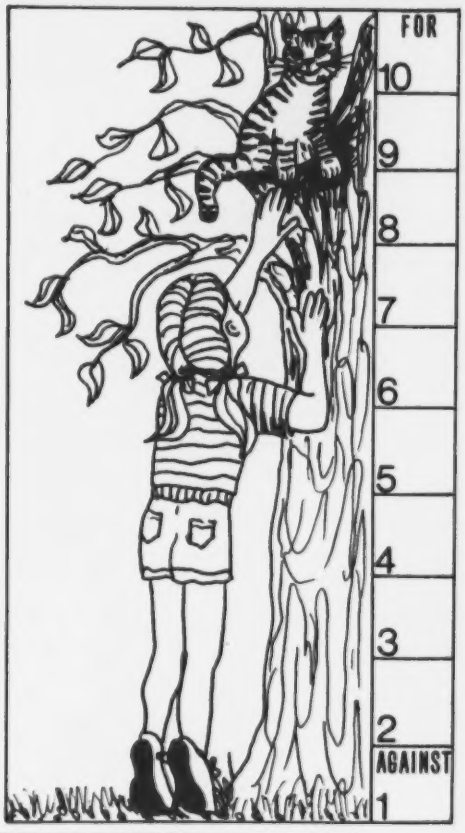

VERY FAIR SKIN—OFTEN FRECKLED

FAIR SKIN

DARK BROWN OR BLACK SKIN

VALUES

Sometimes scientists tell people how they value or feel about something. Below is a mini bumper sticker with related statement. Carefully read each. On the 1 (against) to 10 (for) scale, color in the box that best shows your feelings about the statement. Discuss statement with your teacher, friends and parents. Then in the box below design your own bumper sticker that best shows how you feel about the issue. EXTRA: Design a bumper sticker activity and related statement on a topic of your choice. Have family members complete the activity and discuss the topic with you.



55 M.P.H.

It's a Law We Can Live With

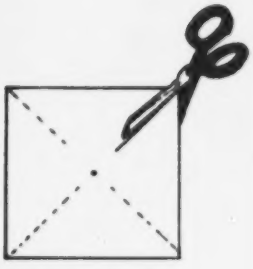
Mini Bumper Sticker

STATEMENT:
The 55 m.p.h. speed limit encourages conservation of energy and should be strictly enforced.

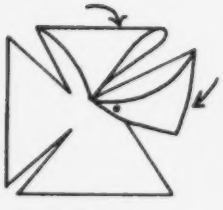
Statement

WIND

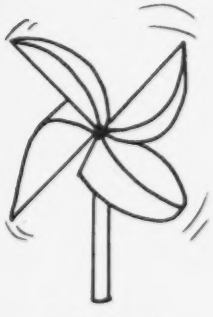
Energy from the wind can be used to do work. Such is the case of a windmill which can grind grain, pump water and generate electricity. In addition, windmills do not burn fuel or cause pollution. Cut out pinwheel windmill pattern below on solid lines. Then cut inward on dotted lines. Fold corners with dots into center. Be sure corner dots overlap center dot. Attach all dots with a straight pin. Push pin through center dot. Attach pin to end of a soda straw. Blow on pinwheel to do work. Count how many times you can make the windmill spin in one long breath's time. Use a fan or hair dryer to turn pinwheel. Compare with windmill. Write a story on how a windmill does work. EXTRA(S): (1) With a friend, develop a script for a television program that features 20 questions whose answers can be found blowing in the wind. "Tornado" may be an answer to one such question. (2) Look up what the Beaufort Scale means. (3) Color the pinwheel to see if you can make a color wheel of white light.



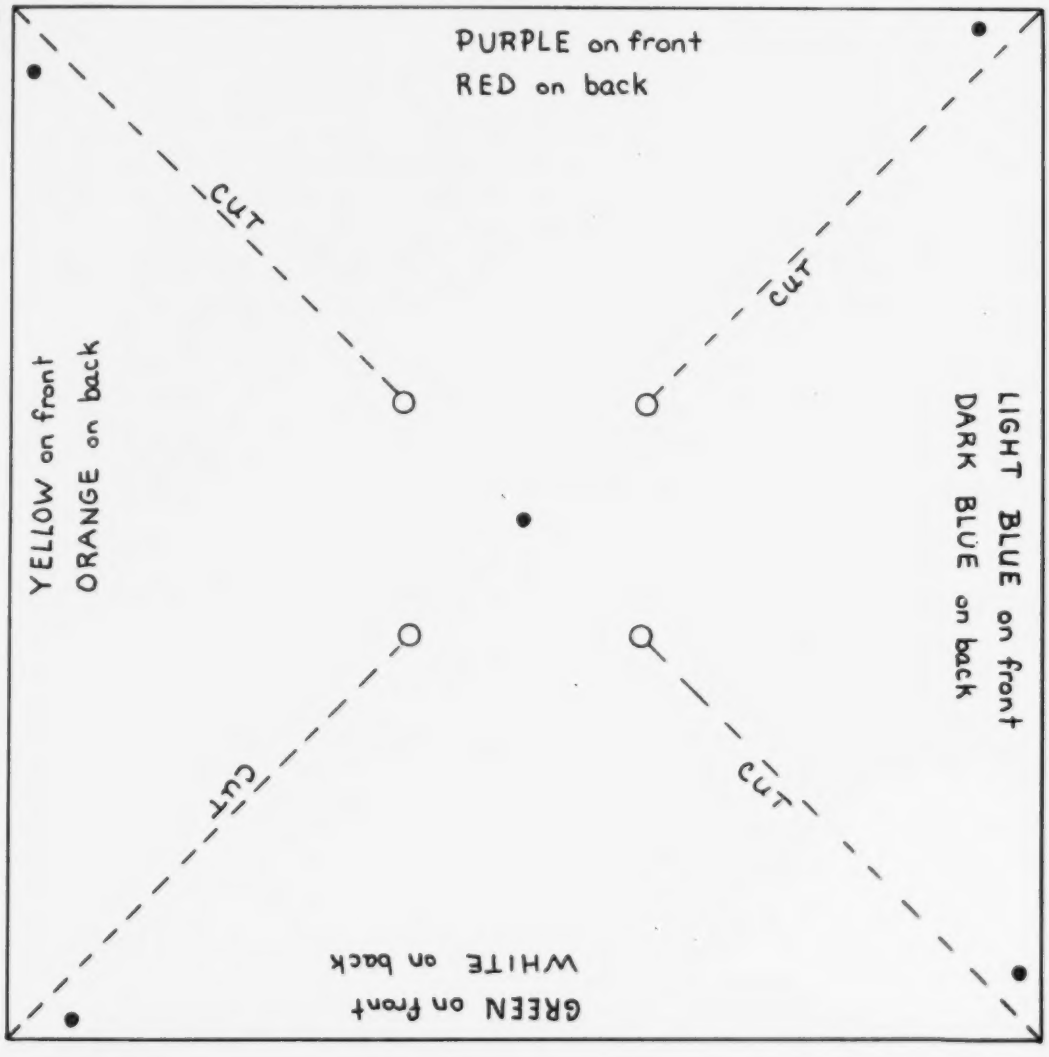
STEP 1



STEP 2



STEP 3

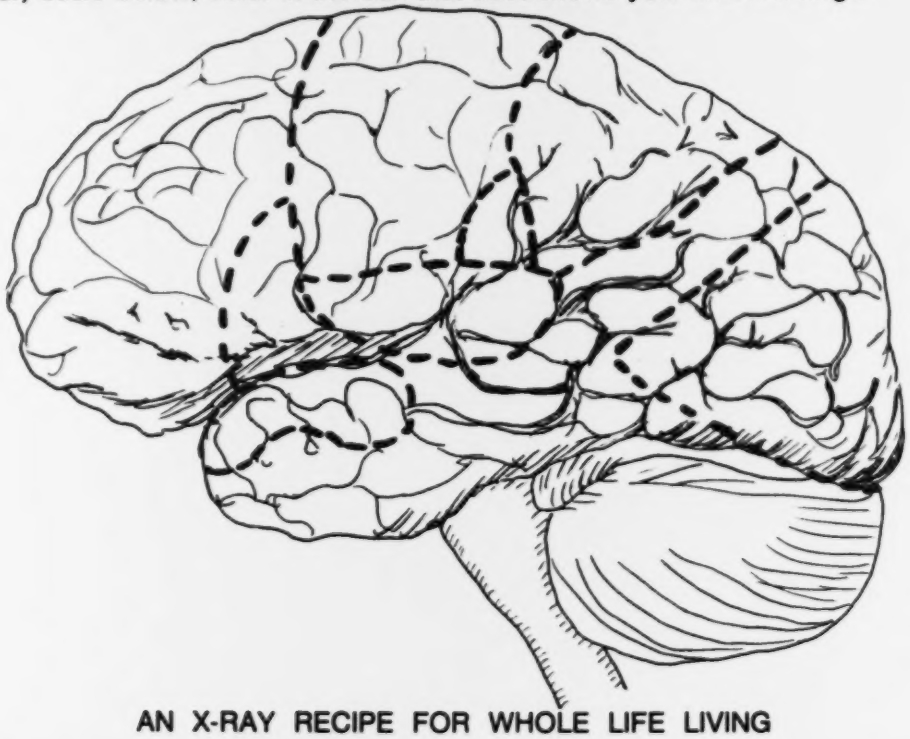


X-RAY

An X-ray allows one to see through solid objects such as the human skull in order to look at the brain. Below is an X-ray of areas in the brain which allow you to do certain things. Carefully read statements A-F. Write the letter on the part of the brain which allows you to do the activity. EXTRA: Find out how a cat scanner works and how it helps detect tumors in the brain.

A Area of brain that helps you *see* a beautiful flower.
B Area of brain that helps you *feel* a smooth rock.
C Area of brain that helps you *hear* pleasant music.
D Area of brain that helps you *taste* an ice-cream cone.
E Area of brain that helps you *smell* pizza.
F Area of brain that helps you *say* kind things to your friends.

X-rays are not able to detect our inner thoughts which we know are there. On the 1 (against) to 10 (for) scale below, color in the box that best shows your inner feelings.



AN X-RAY RECIPE FOR WHOLE LIFE LIVING

Against									For
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10

Eat Less, Breathe More
Talk Less, Think More
Ride in Car Less, Walk More
Waste Less, Give More
Talk Less, Practice More
Frown Less, Laugh More
Boast Less, Build More
Condemn Less, Cheer More
Hate Less, Love More

YOUR ENERGY

You will see yourself as a person full of energy when you eat three meals per day and exercise regularly. Exercise works off calories stored as body fat. Complete the number sentences below to find out how many minutes of walking, running, and bicycling are needed to burn off calories in foods. Then in the last column record the approximate time in minutes you spend walking, running, or bicycling per day.

Food	Amount	Minutes of Walking	+ or − Minutes	Minutes of Running	+ or − Minutes	Minutes of Bicycling	Minutes per Day Walking (W) Running (R) Bicycling (B)
Banana	Medium	24	−17 =	?	+13 =	?	W = R = B =
Hamburger	Medium	?	−48 =	19	+35 =	?	W = R = B =
Hot Dog	Medium	?	−40 =	?	+29 =	45	W = R = B =
Orange	Medium	14	−10 =	?	+ 8 =	?	W = R = B =
Pork Chop	Medium	?	−18 =	7	+13 =	?	W = R = B =
Ice Cream	1 dip	?	−16 =	?	+12 =	18	W = R = B =
French Fries	20	106	−76 =	?	+54 =	?	W = R = B =
Potato Chips	10	?	−16 =	6	+12 =	?	W = R = B =
Cheese Pizza	⅛ of 10"	?	−66 =	?	+48 =	75	W = R = B =
Cheeseburger	Medium	59	−42 =	?	+30 =	?	W = R = B =
Apple	Medium	?	−12 =	6	+ 9 =	?	W = R = B =

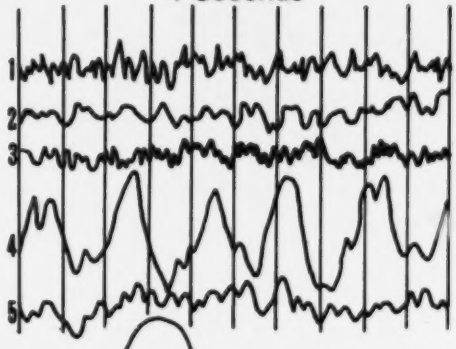
ZZZZ...

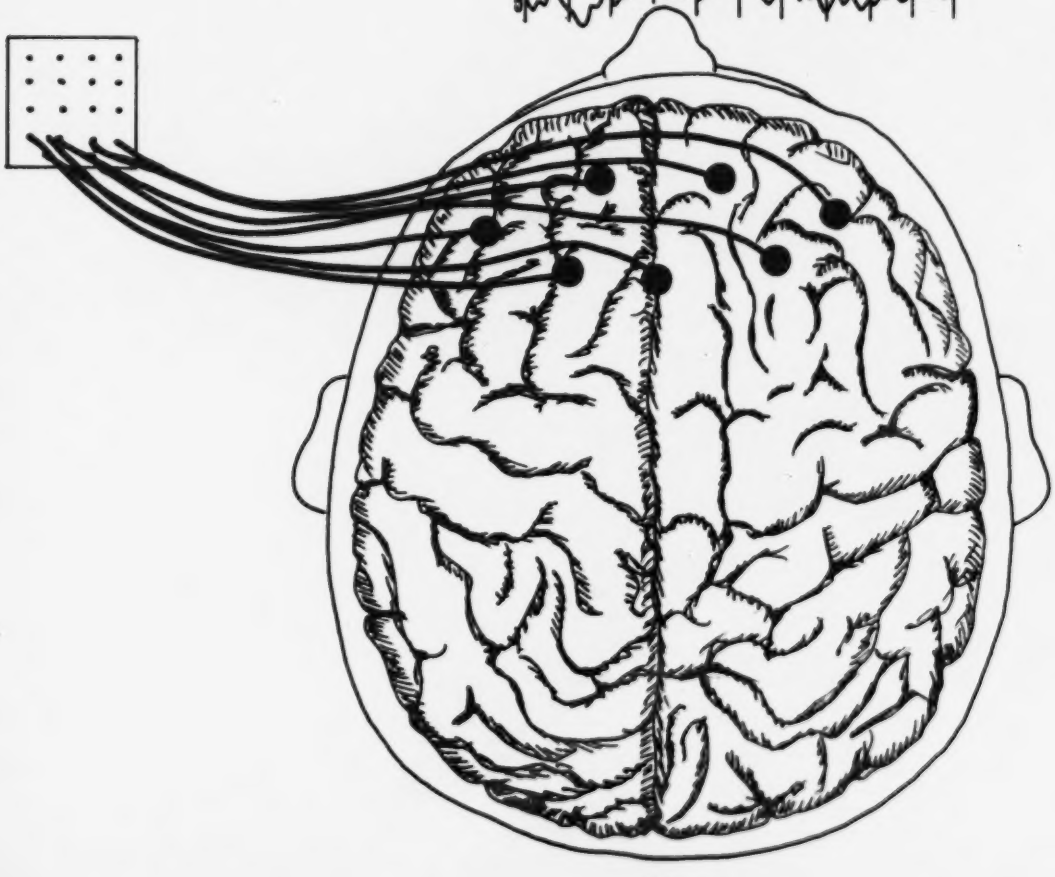
Sleep, often shown by a string of ZZZZ's, is a time when people are not aware of their surroundings. During sleep the body continues to use and give off energy even though activity is less, muscles relax and heart and breathing rates go down. The brain, however, remains very active. It gives off energy in the form of electrical waves. Below are five pictures and descriptions of such waves given off by the front part of your brain during sleep.

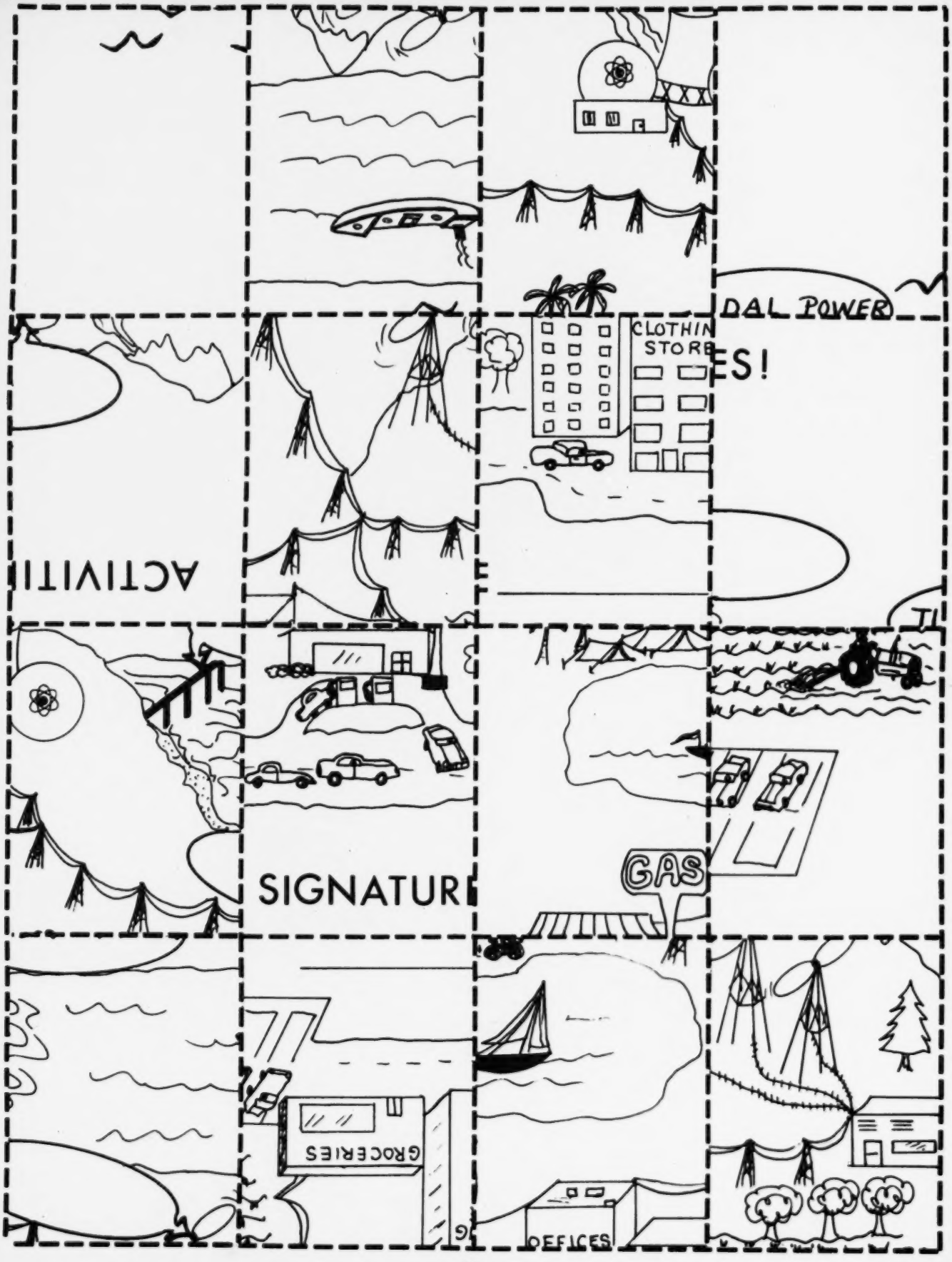
With a pen or pencil, trace over each wave. Then count the number of peaks (high points) and valleys (low points) in each. Record these numbers in the chart. Which wave has the fewest number of peaks (least activity)? Pretend you have fallen asleep and dreamed for ten years. Write a story about the number of changes that took place while you were dreaming. EXTRA: Use a dictionary to define the word *electroencephalograph*.

4 Seconds Peaks Valleys

1. Awake but resting with eyes closed.
2. Sleep begins.
3. Deeper sleep.
4. Deepest sleep.
5. Dreaming.






DAL POWER
CLOTHIN
STORE
ES!
ACTIVITI
SIGNATURE
GAS
GROCERIES
OFFICES

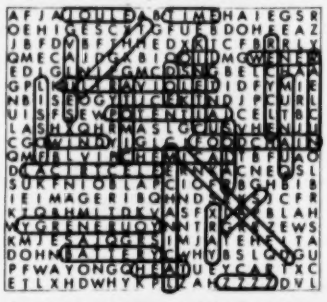
TEACHER/PARENT GUIDE

THE WORD IS ENERGY

Activity Page Number 11

Special Tips: This seek-a-word puzzle features A-Z words that make up the titles of activities in this book.

Answers: Completed activity sheet looks like this:



YOUNG SCIENTISTS EXPLORE ENERGY

(front cover)

Activity Page Number 1

Materials: Scissors, glue, marking pens or crayons, stiff cardboard (8¼" x 11" cardboard from back of writing tablets) or tagboard, laminating machine if available.

Special Tips: Have youngsters cut activity sheet into designated 16 squares. Rearrange puzzle pieces to make complete picture. Glue pieces in place onto cardboard or tagboard. Add names of student and school. Color. Decorate. Use as front cover for Student's Book. Students write names of sources of energy in bubbles on cover. Duplicate back cover of Student Book (activity page 28). Follow same procedure. Laminate both covers. Tape front cover to back cover and use as a folder for pages that make a complete Student Book. Youngsters can also use a 3-ring binder or file folder for this purpose.

Answers: Completed project looks like this:

ATOMIC ENERGY

Activity Page Number 2

Special Tips: This advanced crossword puzzle contains the identification of various nuclear energy related concepts.

Answers: DOWN: (1) alloys, (2) medico, (5) orbit, (6) alpha, (7) power, (8) cutie, (9) radio, (10) eight, (11) Fermi, (12) water, (14) shield, (17) decay, (18) earth, (19) gamma, (22) chain, (23) boron, (25) blood, (27) Dy, (28) Co, (30) rare, and (31) Fe
ACROSS: (1) atom, (3) lead, (4) hot, (6) amp, (8) curie, (12) war, (13) raw, (14) slug, (15) ion, (16) dose, (17) dee, (19) gas, (20) Mo, (21) age, (22) cob, (24) air, (25) BTU, (26) day, and (29) ore, (32) air

BATTERY

Activity Page Number 3

Special Tips: Encourage examination of battery in family automobile and safety procedures when jumping a car, e.g., + pole to + pole, − pole to − pole.

Answers: Parts of battery: (1) cover, (2) positive pole, (3) filler cap, (4) negative pole, (5) negative plate, (6) separator, (7) positive plate, (8) acid, (9) hard rubber case
(3) 6 cells, 2 volts per cell, 12 volt battery
(4) answers will vary
(5) storage battery includes two or more cells; dry cell is one cell

CHEMICAL ENERGY

Activity Page Number 4

Special Tips: Stress the importance of eating well-balanced meals, proper diet and daily exercise.

Answers: Answers will vary.

DEPARTMENT OF ENERGY

Activity Page Number 5

Special Tips: Teachers may acquire energy related teaching materials by sending a letter to the Department of Energy Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

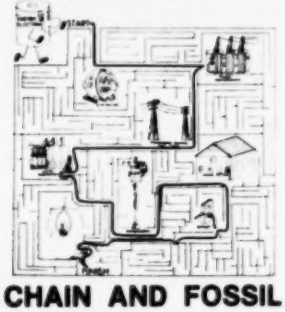
Answers: (1) solar, (2) petroleum, (3) nuclear, (4) wind, (5) hydroelectric

ELECTRICAL ENERGY

Activity Page Number 6

Special Tips: After completion of activity, discuss what happens in the production of energy at each stop in the maze.

Answers: Distance: 26 in. (65 cm) - 29 in. (72.5 cm). Completed activity sheet looks like this:



FOOD CHAIN AND FOSSIL FUELS

Activity Page Number 7

Special Tips: Laminate cards to prevent tearing. String together with string or yarn. Cards can also be taped together to show correct sequence in food chain.

Answers: Correct sequence: Farmer Plants Seeds (✓), Farmer Cultivates Small Corn Plants (✓), Farmer Irrigates Corn Plants (✓), Farmer Chops Corn (✓), Cow Eats Corn (✓), Cow Transported on Truck (✓), Cow to Stockyard Slaughterhouse (✓), Meat to Meat Processor (✓), Meat from Meat Processor to Supermarket (✓), Car to Supermarket to Purchase Meat (✓), Meat Cooking in Oven (✓), People Eating Meat ( )

GAS

Activity Page Number 8

Special Tips: Teach youngsters how to read their gas meters at home, and encourage them to report on the amount of gas used per day.

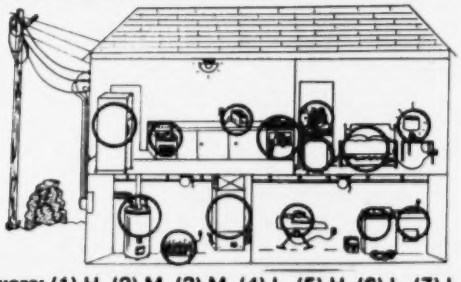
Answers: (1) B, (2) E, (3) C, (4) D, (5) G, (6) A, (7) F

HEAT ENERGY

Activity Page Number 9

Special Tips: Introduce youngsters to Ohm's Law, E = I/R where E = voltage (volts) I = Current (amps) and R = Resistance (ohms). Calculate how many watts of energy are needed daily to operate each identified energy user in the home.

Answers: Completed activity sheet looks like this:



Answers: (1) H, (2) M, (3) M, (4) L, (5) H, (6) L, (7) L, (8) M, (9) H, (10) M, (11) L, (12) H, (13) H, (14) M

INFRARED ENERGY

Activity Page Number 10

Special Tips: Extend activity to include a discussion of therograms, which are infrared pictures that show heat loss from homes and businesses.

Answers: Colors should match letters; white, most heat given off, black, least heat given off by the body. Person on left wears summer clothing; person on right wears winter clothing.

JAMES P. JOULE

Activity Page Number 11

Special Tips: Encourage youngsters to lift the same objects over a longer distance and/or lighter or heavier objects over the same distance.

Answers: pool, Joule, work, energy, work, energy, work, energy, work, work, energy, energy, heat, joule. Ten joules.

KINETIC ENERGY

Activity Page Number 12

Special Tips: This activity presents the development of various forms of energy throughout history. Insert cardboard washers between discs for easy spin. A straight paper clip can be used as a center pin.

Answers: muscle—carry large stone, water—water wheel, solar—solar panel, wind—windmill, steam—steam engine, electrical—railroad trolley, petroleum—automobile, nuclear—nuclear power plant.

LIGHT ENERGY

Activity Page Number 13

Special Tips: Encourage youngsters to make various objects with shadows cast by their hands.

Answers: (1) Hair dryer, (2) Iron, (3) Silhouette, (4) Automobile, (5) Hot water heater, (120°—49°C) suggested termperature setting for hot water heater), (6) Mixer, (7) Electric toothbrush, (8) Incandescent, (9) Motorcycle

MECHANICAL ENERGY

Activity Page Number 14

Special Tips: Compare a four-cycle gasoline engine with a diesel engine. A diesel engine has no spark plugs but uses compression to ignite fuel in the cylinder chamber.

Answers: Sequence—1-8-3-9-7-2-4-5-6.

NUCLEAR ENERGY

Activity Page Number 15

Special Tips: Have youngsters study how the sun produces its energy by fusion.

Answers: Answers will vary.

OIL

Activity Page Number 16

Special Tips: Ask the art teacher to give a demonstration lesson on painting with oils.

Answers: Completed activity sheet looks like this:

POTENTIAL ENERGY

Activity Page Number 17

Special Tips: Stress safety when handling metal banding.

Answers: Charts A and B answers will vary. Variables listed in chart C may include weight of clay and type of banding used.

QUANTUM

Activity Page Number 18

Special Tips: Discuss the differences in primary colors of *light* and primary *paint* colors. Red, green and blue *light* colors can be mixed to make any other color. Red and green *light* mixed gives yellow light. If yellow light and blue light are mixed, one gets white light. White paint is not possible when mixing the three primary *paint* colors of yellow, blue and red as yellow and blue yield green.

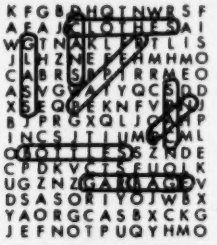
Answers: (1) About 8 minutes (2) Unit of distance that light travels in one sidereal year, about 6 million miles. This unit has been replaced by another unit called the Parsec. (3) 186,000 mi. (297,600 km) per second (4) Primary *light*colors are red, green and blue. Primary *paint* colors are yellow, blue and red. (5) Violet (6) Red (7) Theory in science that deals with physical events that cannot be seen directly.

RENEW BY RECYCLING

Activity Page Number 19

Special Tips: Using home telephone books or newspaper announcements, encourage youngsters to make a permanent record of the name, address and telephone number of the nearest recycling center in their city.

Answers: Completed activity sheet looks like this:



SOLAR ENERGY

Activity Page Number 20

Special Tips: Remind youngsters to start with ice cubes of the same size, preferably those that are made in plastic trays with small compartments. To preserve activity sheet, youngsters can glue construction paper to another sheet of paper thus keeping the original sheet intact.

Answers: Ice cube on the black square should melt first. (1) F, (2) T, (3) T, (4) T

TIME

Activity Page Number 21

Special Tips: Students may tape frames together to make a roll filmstrip of energy events.

Answers: (1) Volta: Electricity, 1800 (2) Fulton: Steamboat, 1807 (3) McCormick: Reaper, 1834 (4) Lenoir: Internal Combustion Engine, 1860 (5) Benz: Automobile, 1885 (6) Wright brothers: Airplane, 1903 (7) Einstein: $E = MC^2$, 1905 (8) Ford: "Model T," 1910 (9) Goddard: Rocket, 1926 (10) Fermi: Nuclear Reaction, 1942

ULTRAVIOLET

Activity Page Number 22

Special Tips: Emphasize proper safety precautions be taken to protect one's skin from excessive exposure to ultraviolet rays.

Answers: (1) F, (2) T, (3) T, (4) T, (5) F, (6) T, (7) F, (8) T, (9) T, (10) T, (11) F, (12) T, (13) T, (14) F

VALUES

Activity Page Number 23

Special Tips: Teacher should assume a neutral position on the issue.

Answers: Answers will vary.

WIND

Activity Page Number 24

Special Tips: A pencil with eraser can be substituted for the soda straw to hold pinwheel together.

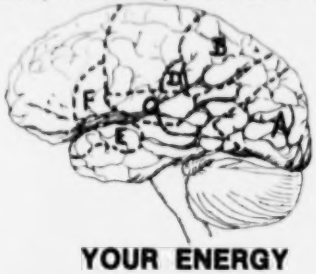
Answers: Completed pinwheel.

X-RAY

Activity Page Number 25

Special Tips: Extend discussion into left and right brain thinking and learning.

Answers: Completed activity sheet looks like this:



YOUR ENERGY

Activity Page Number 26

Special Tips: Stress the importance of proper diet and regular exercise. Discuss four basic food groups and snack foods.

Answers: (7, 20), (67, 54), (56, 16), (4, 12), (25, 20), (22, 6), (36, 90), (22, 18), (93, 27), (17, 47), (18, 15)

ZZZZ...

Activity Page Number 27

Special Tips: Obtain EEG or EKG recording tape from a physician. Show youngsters how to interpret such a message.

Answers:

	Peaks	Valleys	
1.	40	38	Fewest Peaks
2.	24	22	and Valleys = Deep Sleep
3.	40	42	
4.	15	14	
5.	24	24	

ACTIVITIES

Activity Page Number 28

Materials: Scissors, glue, marking pens or crayons, stiff cardboard (8½" x 11" cardboard from back of writing tablets) or tagboard, laminating machine if available.

Special Tips: Follow front cover procedures.

Answers: Completed project looks like this: